



Report No. 2-300209

Test Report

Product	Gateway
Name and address of the applicant	Develco Products Olof Palmes Alle 40, DK-82000 Århus N, Denmark
Name and address of the manufacturer	Develco Products Olof Palmes Alle 40, DK-82000 Århus N, Denmark
Model	MGW101
Rating	5Vdc
Trademark	Develco
Serial number	Radiated sample: 0200000100001516 Conducted sample: 02000001000012EE
Additional information	This product SquidLink contains four radio units: - Wi-Fi covered by this test report - Zigbee covered by test report 1-300209 - GSM module ,U-Blox (FCC ID: XPY SARAU280; IC: 8595A-SARAU280) - Z-Wave module, 902–928 MHz (FCC ID: D87-ZM5304-U; IC: 11263A-ZM5304)
Tested according to	FCC Part 15.247 Digital Transmission Systems Industry Canada RSS-247, Issue 1 Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
Order number	300209
Tested in period	2016.02.22 - 2016.03.17 and 2016.08.03
Issue date	2016.08.03
Name and address of the testing laboratory	 Instituttveien 6 Kjeller, Norway FCC No: 994405 IC OATS: 2040D-1 TEL: +47 22 96 03 30 FAX: +47 22 96 05 50
Prepared by [G.Suhanthakumar] Approved by [Frode Sveinsen]	
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Nemko Norway

Nemko AS, Instituttveien 6, P.O. Box 96 Kjeller, 2027 Kjeller, Norway
TEL +47 22 96 03 30 FAX +47 22 96 05 50 EMAIL info@nemko.com
ENTERPRISE NUMBER NO974404532

nemko.com/no

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1 INFORMATION

1.1 Test Item

Name :	SquidLink
FCC ID :	2AHNM-GC981709
Industry Canada ID :	21398-GC981709
Model/version :	MGW101
Serial number :	Radiated sample: 0200000100001516 Conducted sample: 02000001000012EE
Hardware identity and/or version:	4.0.x
Software identity and/or version :	1.2.x
Frequency Range :	2412 - 2462MHz
Number of Channels :	11
Channel separation:	20MHz
Type of Modulation :	IEEE 802.11b/g/n
User Frequency Adjustment :	N/A
Rated Output Power :	0.038W
Type of Power Supply :	5Vdc
Antenna Connector :	None (PCB antenna)
No of Antennas:	1
Antenna Diversity Supported :	N/A
Desktop Charger :	None

Description of Test Item

The Squid. Link Gateway from Develco Products are flexible platforms for connecting elements in your Smart Home system with a control unit. They support a wide range of communication protocols, with state-of-the art data encryption to keep your data streams safe and private. The gateways are based on a programmable Linux-platform and support Java and OSGI.

The gateway is modular and can handle many different wireless protocols at the same time. Supported protocols are i.a. ZigBee, Z-Wave, Wireless M-Bus, GPRS, ethernet, and WiFi.

Theory of Operation

The Smart Home application running on the Squid.link gateway handles the communication with the different devices installed in the home. The gateway can receive and transmit data messages to/from the devices in the network. All the radios are pr. default RX-On idle.

1.2 Normal test conditions

Temperature: 20 - 24 °C
Relative humidity: 20 - 50 %
Normal test voltage: 5Vdc

The values are the limit registered during the test period.

1.3 Test Engineer(s)

G.Suhanthakumar

1.4 Test Equipment

See list of test equipment in clause 5.

1.5 Description of modification for Modification Filing

Not applicable.

1.6 Family List Rational

Not Applicable.

1.7 Additional Comments

It was checked that power variations between 85% and 115% did not have any influence on the measurements.

All ports were populated during spurious emission measurements.

2 TEST REPORT SUMMARY

2.1 General

All measurements are traceable to national standards.

The tests were conducted for the purpose of demonstrating compliance with FCC CFR 47 Part 15, paragraph 15.247 and Industry Canada RSS-247 Issue 1.

Tests were performed in accordance with ANSI C63.4-2014 and ANSI C63.10-2013.

Radiated tests were performed in a semi-anechoic chamber at measuring distances of 1m, 3m and 10m.

A description of the test facility is on file with the FCC and Industry Canada.

- | | |
|---|---|
| <input checked="" type="checkbox"/> New Submission | <input checked="" type="checkbox"/> Production Unit |
| <input type="checkbox"/> Class II Permissive Change | <input type="checkbox"/> Pre-production Unit |
| DTS Equipment Code | <input type="checkbox"/> Family Listing |



THIS TEST REPORT APPLIES ONLY TO THE ITEM(S) AND CONFIGURATIONS TESTED.

Deviations from, additions to, or exclusions from the test specifications are described in "Summary of Test Data".

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2.2 Test Summary

Name of test	FCC Part 15 reference	RSS-247 Issue 1, RSS-GEN Issue 4 reference	Result
Supply Voltage Variations	15.31(e)	6.11 (RSS-GEN)	Complies
Antenna Requirement	15.203	8.3 (RSS-GEN)	Complies ¹
Power Line Conducted Emission	15.107(a) 15.207(a)	8.8 (RSS-GEN)	Complies
Occupied Bandwidth	N/A	6.6 (RSS-GEN)	
Minimum 6 dB Bandwidth	15.247(a)(2)	5.2 (1) (RSS-247)	Complies
Peak Power Output	15.247(b)	5.4 (RSS-247)	Complies
Power Spectral Density	15.247(d)	5.2 (2) (RSS-247)	Complies
Spurious Emissions (Antenna Conducted)	15.247(c)	5.5 (RSS-247)	Complies ¹
Spurious Emissions (Radiated)	15.247(c) 15.109(a) 15.209(a)	5.5 (RSS-247) 6.13 (RSS-GEN) 8.9 (RSS-GEN)	Complies

¹ The tested equipment has integrated antenna only.

3 TEST RESULTS

3.1 Power Line Conducted Emissions

Para. No.: 15.207 (a)

Test Performed By: G.Suhanthakumar

Date of Test: 2016.03.10

Measurement procedure: ANSI C63.4-2014 using 50 μ H/50 ohms LISN.

Test Results: Complies.

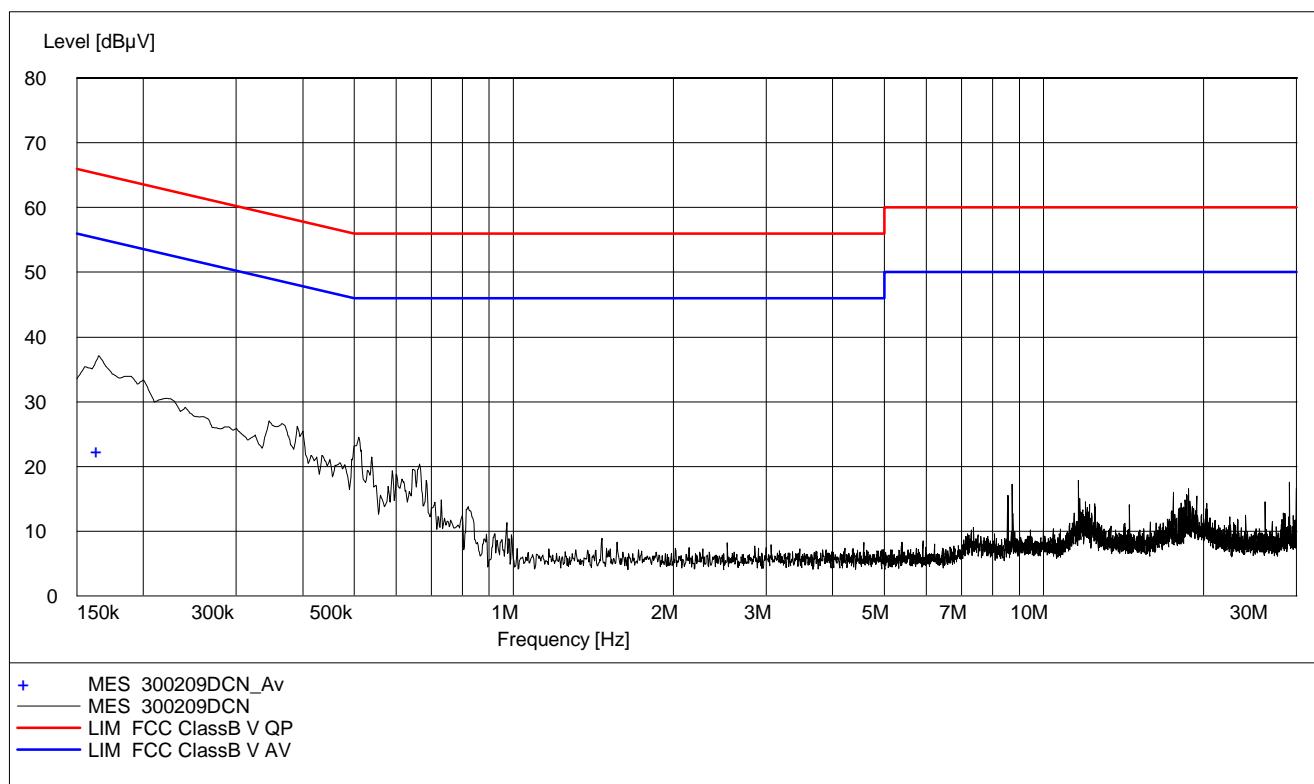
Measurement Data: See attached graph, (Peak detector).

Measured for 5Vdc using Farnell D001 (S/N :001701) power supply and

AC/DC adapter type SMP007B050100

Input voltage to Farnell DC power supply & AC/Dc adapter: 120Vac/60Hz

Highest measured value (L1 and N):



DC power 5Vdc- Regulated Power Supply: Farnell D001

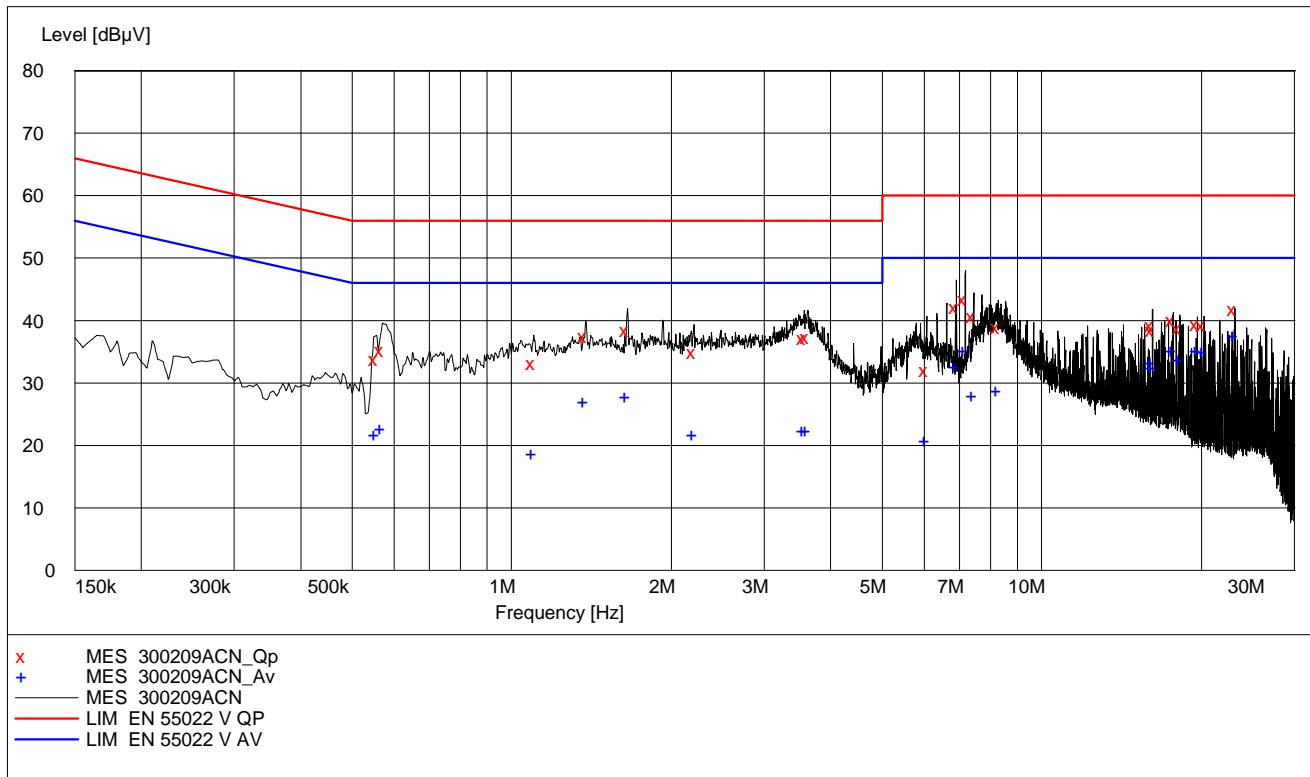


QP detector:

Frequency [MHz]	Level [dBuV]	Af [dB]	Limit [dBuV]	Margin [dB]	Det	Position	Verdict [Pass/Fail]
-	-	-	-	-	QP	-	-

AV detector:

Frequency [MHz]	Level [dBuV]	Af [dB]	Limit [dBuV]	Margin [dB]	Det	Position	Verdict [Pass/Fail]
0.165000	22.30	10.70	55.20	32.90	AV	L1	Pass



AC/DC adaptor type: SMP007B050100

QP detector:

Frequency [MHz]	Level [dBuV]	Af [dB]	Limit [dBuV]	Margin [dB]	Det	Position	Verdict [Pass/Fail]
0.555000	33.80	10.20	56.00	22.20	QP	L1	Pass
0.570000	35.20	10.20	56.00	20.80	QP	N	Pass
1.100000	33.20	10.40	56.00	22.80	QP	L1	Pass
1.380000	37.50	10.40	56.00	18.50	QP	L1	Pass
1.655000	38.50	10.40	56.00	17.50	QP	L1	Pass
2.210000	34.90	10.40	56.00	21.10	QP	L1	Pass
3.570000	37.20	10.40	56.00	18.80	QP	N	Pass
3.615000	37.30	10.40	56.00	18.70	QP	N	Pass
6.070000	32.00	10.50	60.00	28.00	QP	L1	Pass
6.900000	42.20	10.60	60.00	17.80	QP	N	Pass
7.175000	43.40	10.60	60.00	16.60	QP	N	Pass
7.450000	40.70	10.60	60.00	19.30	QP	N	Pass
8.280000	38.90	10.60	60.00	21.10	QP	N	Pass
16.165000	39.20	10.80	60.00	20.80	QP	L1	Pass
16.225000	38.40	10.80	60.00	21.60	QP	N	Pass
17.695000	40.10	10.80	60.00	19.90	QP	L1	Pass
18.240000	38.80	10.80	60.00	21.20	QP	N	Pass
19.710000	39.50	10.80	60.00	20.50	QP	L1	Pass
20.260000	39.20	10.80	60.00	20.80	QP	L1	Pass
23.130000	41.80	11.00	60.00	18.20	QP	L1	Pass



AV detector:

Frequency [MHz]	Level [dBuV]	Af [dB]	Limit [dBuV]	Margin [dB]	Det	Position	Verdict [Pass/Fail]
0.555000	21.70	10.20	46.00	24.30	AV	L1	Pass
0.570000	22.80	10.20	46.00	23.20	AV	N	Pass
1.100000	18.70	10.40	46.00	27.30	AV	L1	Pass
1.380000	27.00	10.40	46.00	19.00	AV	L1	Pass
1.655000	27.80	10.40	46.00	18.20	AV	L1	Pass
2.210000	21.70	10.40	46.00	24.30	AV	L1	Pass
3.570000	22.50	10.40	46.00	23.50	AV	N	Pass
3.615000	22.50	10.40	46.00	23.50	AV	N	Pass
6.070000	20.80	10.50	50.00	29.20	AV	L1	Pass
6.900000	32.60	10.60	50.00	17.40	AV	N	Pass
7.175000	35.20	10.60	50.00	14.80	AV	N	Pass
7.450000	28.10	10.60	50.00	21.90	AV	N	Pass
8.280000	28.90	10.60	50.00	21.10	AV	N	Pass
16.165000	33.40	10.80	50.00	16.60	AV	L1	Pass
16.225000	32.50	10.80	50.00	17.50	AV	N	Pass
17.695000	35.30	10.80	50.00	14.70	AV	L1	Pass
18.240000	33.80	10.80	50.00	16.20	AV	N	Pass
19.710000	35.20	10.80	50.00	14.80	AV	L1	Pass
20.260000	35.10	10.80	50.00	14.90	AV	L1	Pass
23.130000	37.60	11.00	50.00	12.40	AV	L1	Pass



3.2 Occupied Bandwidth

Para. No.: 15.247 (a)(1)(iii)

Test Performed By: G.Suhanthakumar	Date of Test: 2016.02.23
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Test Results: Complies

Measurement Data:

Modulation type and bitrate	Occupied Bandwidth (99% BW) MHz		
	Ch 01, 2412 MHz	Ch 06, 2437 MHz	Ch 11, 2462 MHz
802.11b, 5.5 Mbps	15.23	-	-
802.11g, 9 Mbps	-	16.37	-
802.11n, 65 Mbps	-	-	18.19

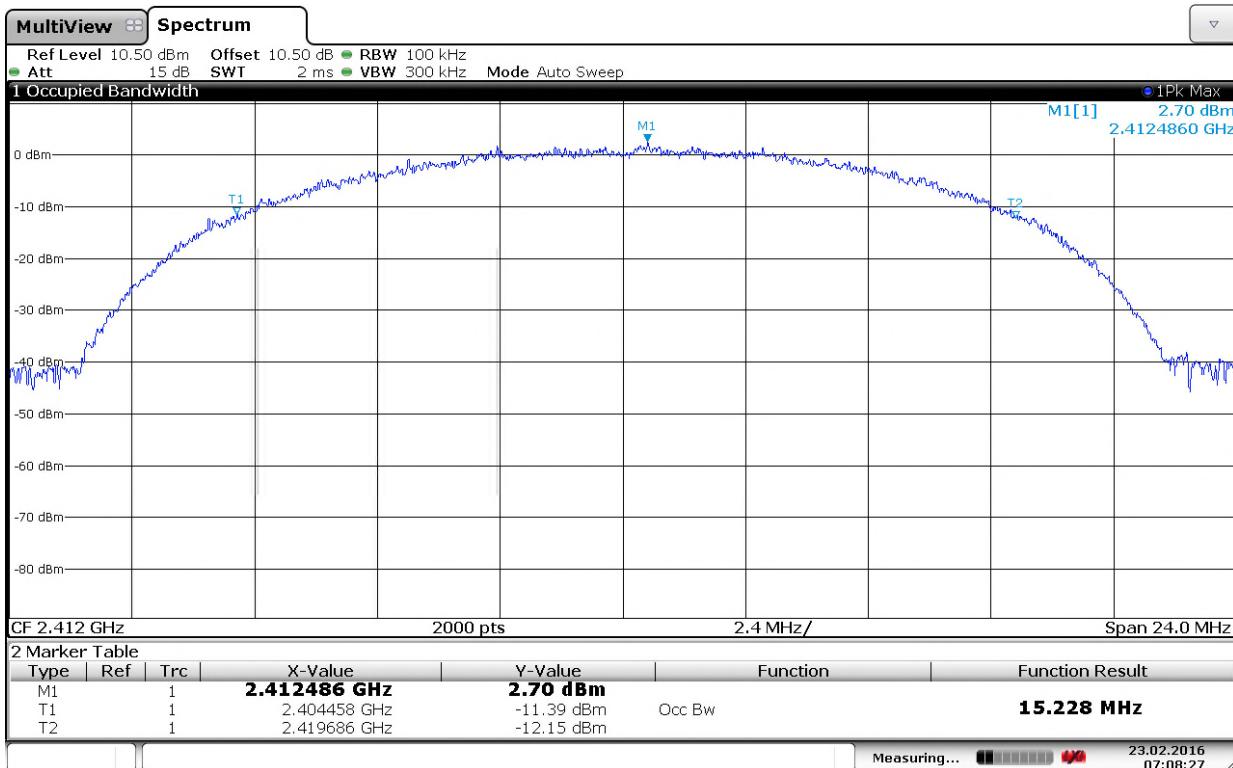
Occupied Bandwith is reported for information only.

See attached graph.

Requirements:

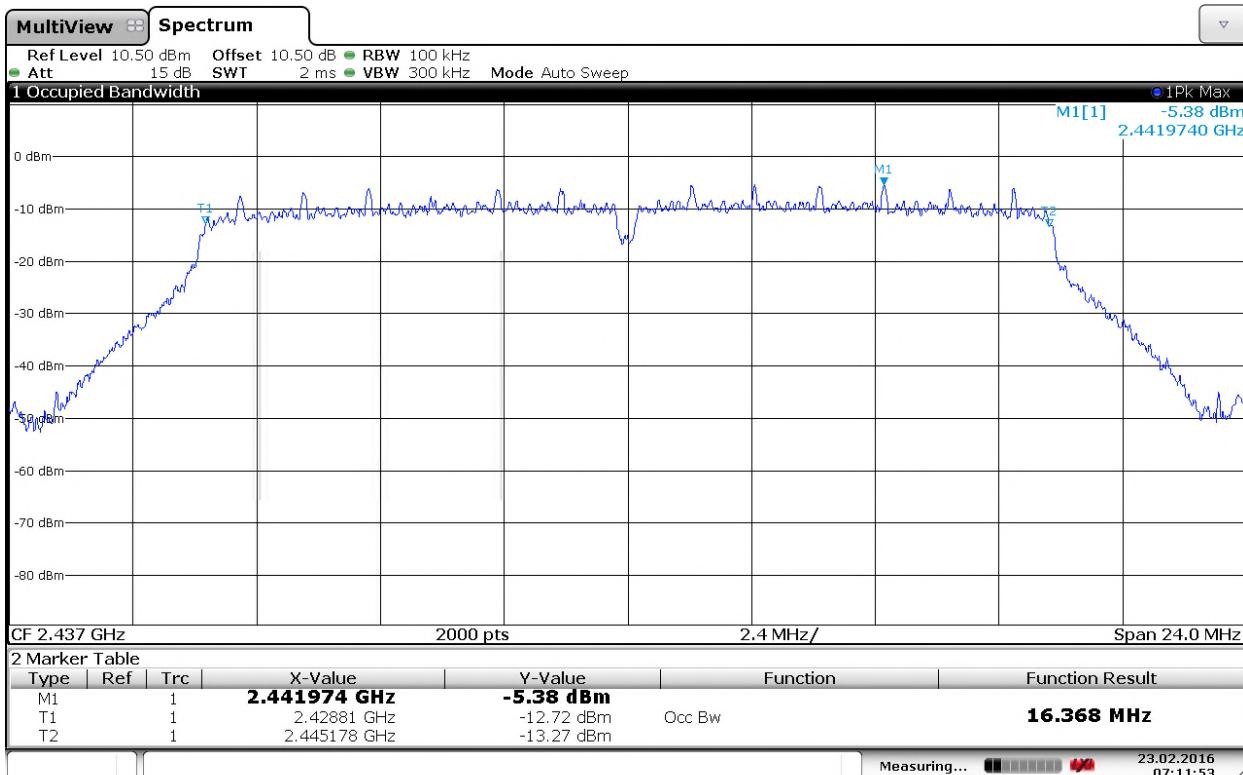
Frequency hopping systems in the 2400 - 2483.5 MHz band shall use at least 15 non-overlapping channels.
No requirements for bandwidth for this frequency band.

No requirements for Digital Transmission Systems.



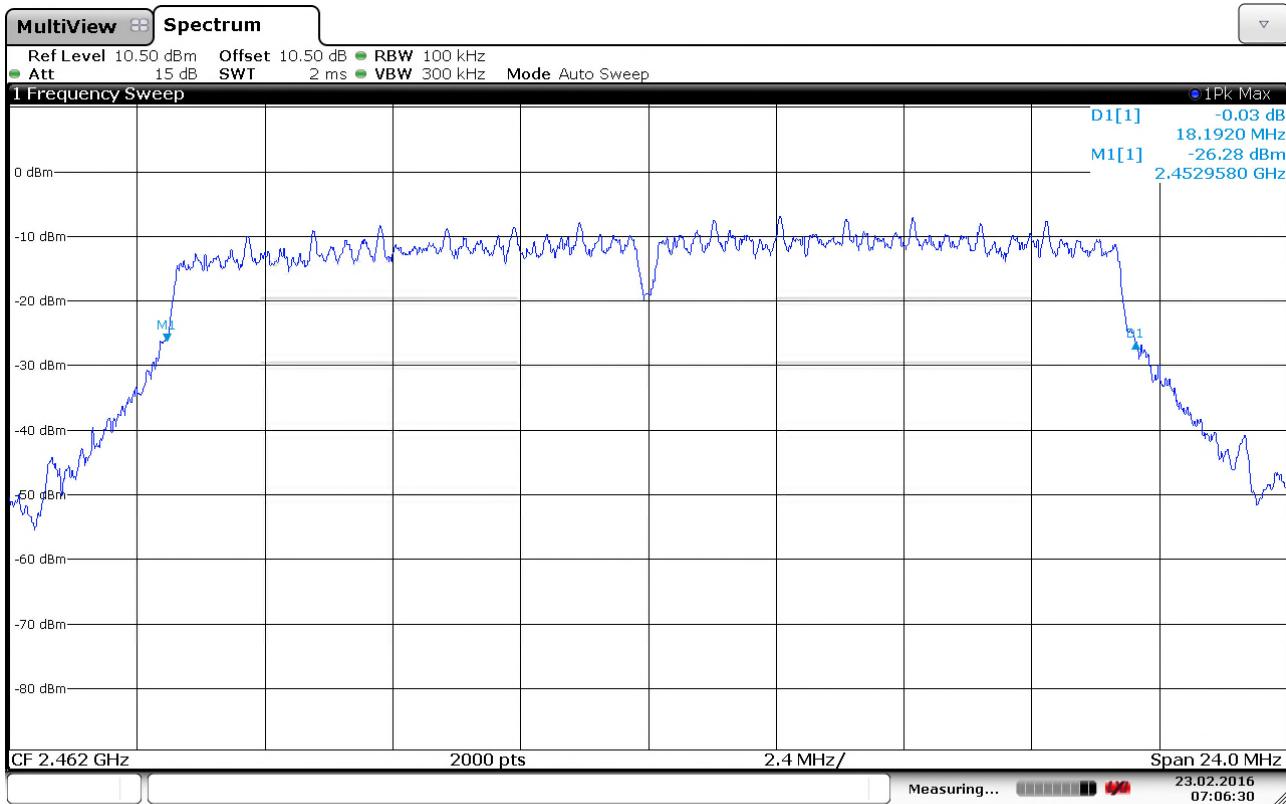
Date: 23.FEB.2016 07:08:27

Occupied Bandwidth, 2412 MHz, 802.11b, 5.5Mbps



Date: 23.FEB.2016 07:11:53

Occupied Bandwidth, 2437 MHz, 802.11g, 9Mbps



Date: 23.FEB.2016 07:06:31

Occupied Bandwidth, 2462 MHz, 802.11n, 65Mbps

3.3 Minimum 6 dB Bandwidth

Para. No.: 15.247 (a)(2)

Test Performed By: G.Suhanthakumar	Date of Test: 2016.02.23
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Test Results: Complies

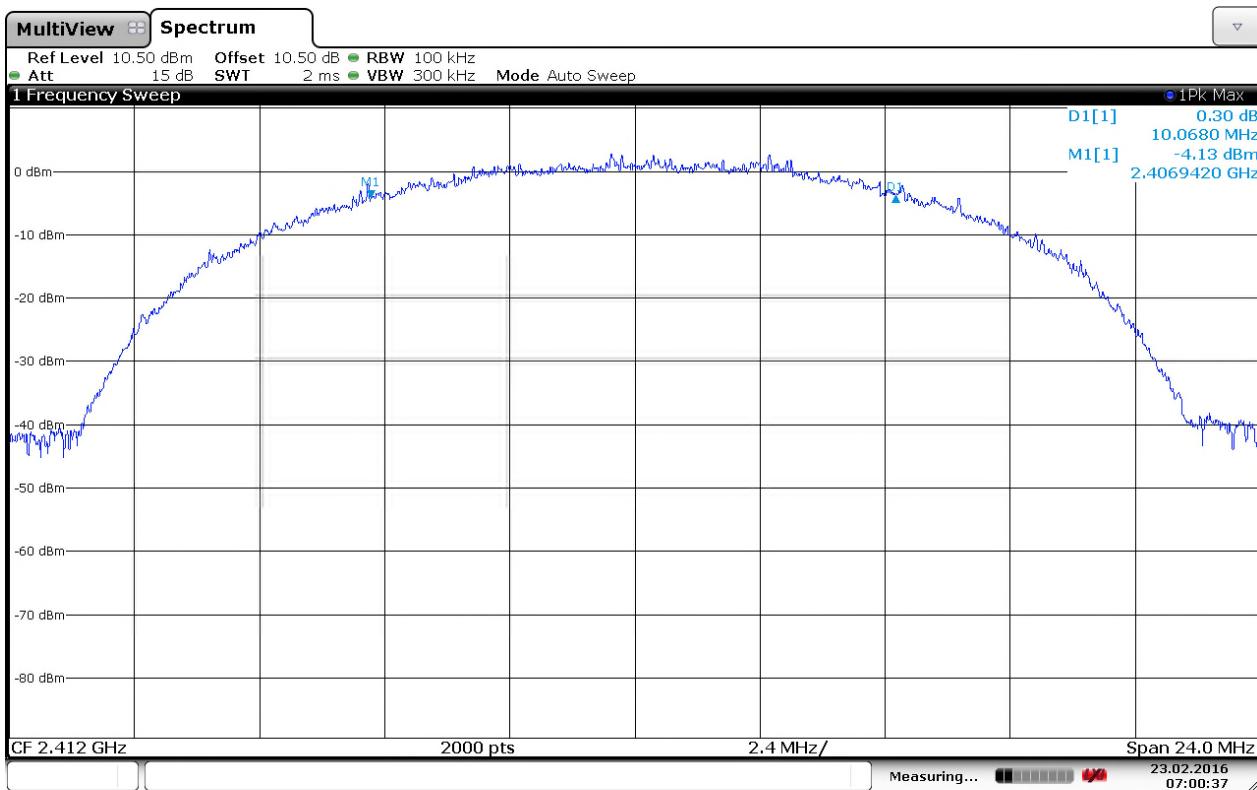
Measurement Data:

Modulation type and bitrate	Measured 6 dB Bandwidth (MHz)		
	Ch 1, 2412 MHz	Ch 6, 2437 MHz	Ch 11, 2462 MHz
802.11b, 5.5 Mbps	10.07	10.68	10.50
802.11g, 9 Mbps	16.32	16.31	16.31
802.11n, 65Mbps	17.60	17.58	17.64

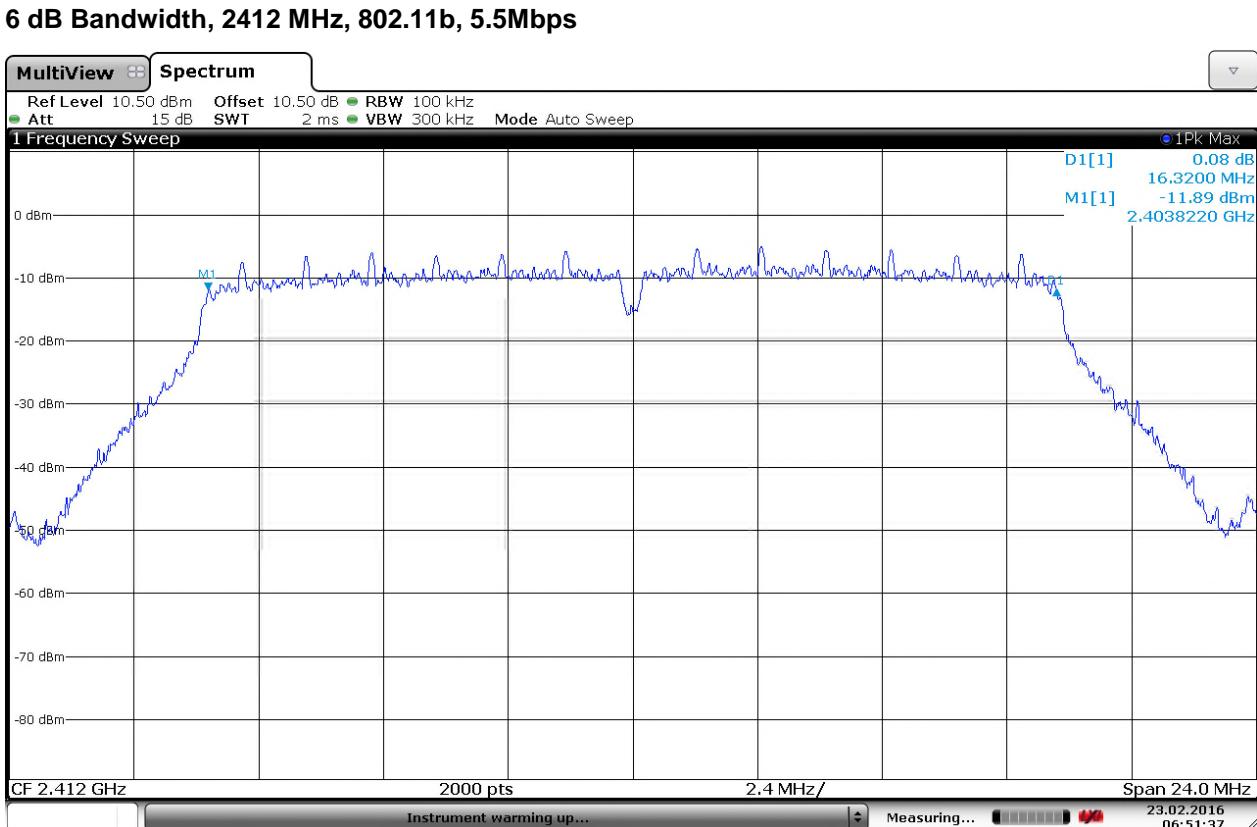
Power supply variation within 85 % to 115% of nominal value has no influence on measured value.

Requirements:

For Digital Transmission Systems in the 2400-2483.5 MHz band the minimum 6 dB bandwidth shall be at least 500 KHz.

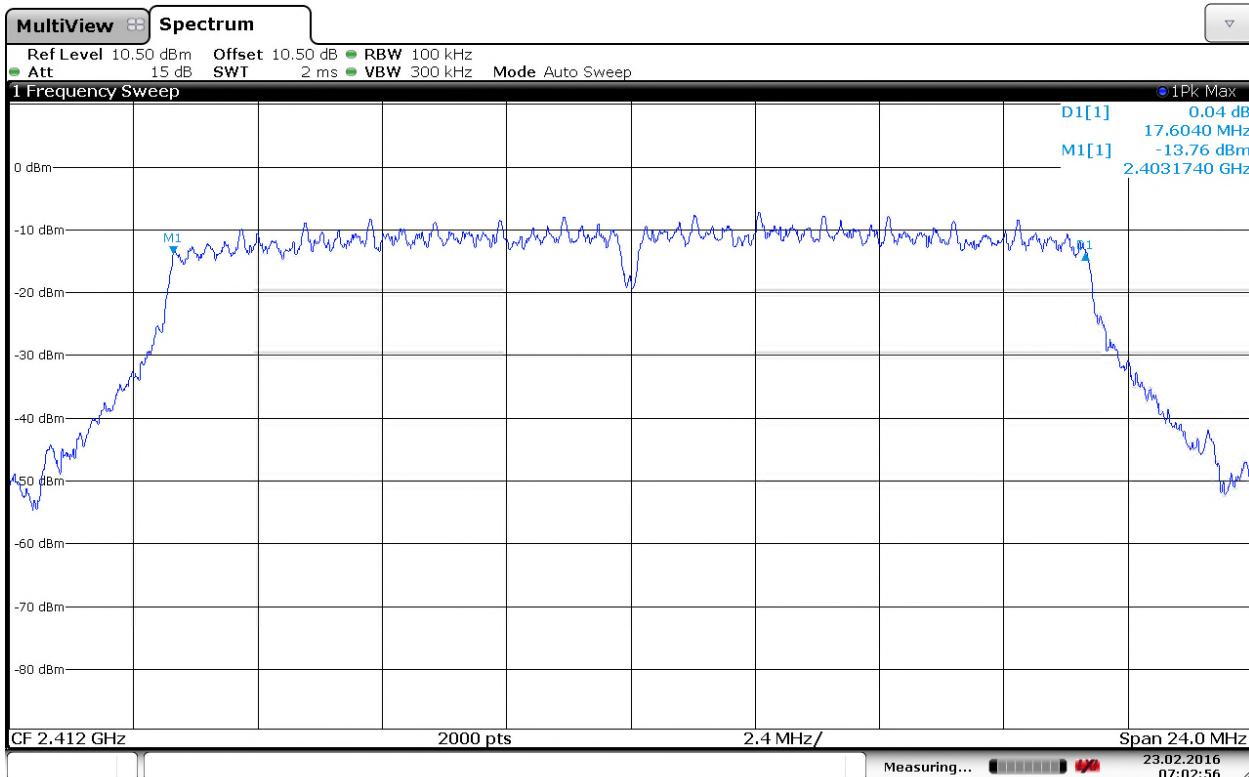


6 dB Bandwidth, 2412 MHz, 802.11b, 5.5Mbps



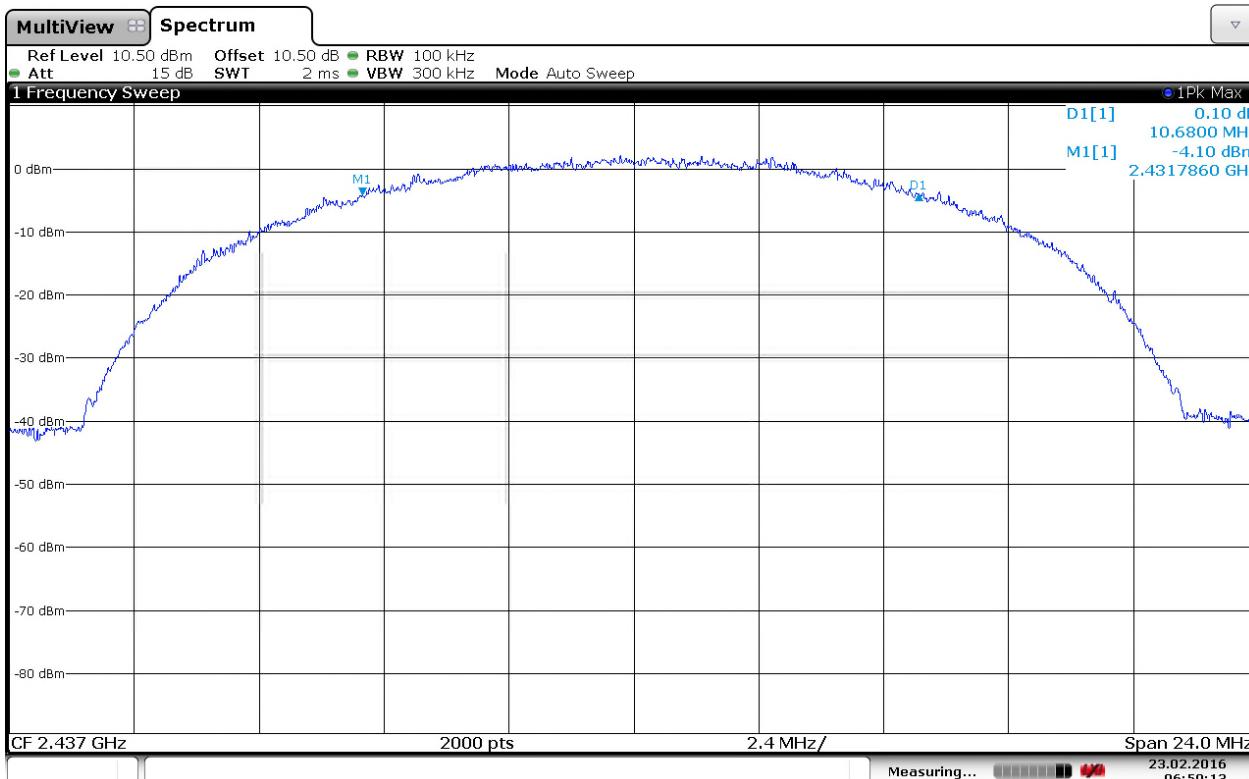
Date: 23.FEB.2016 06:51:37

6 dB Bandwidth, 2412 MHz, 802.11g, 9Mbps



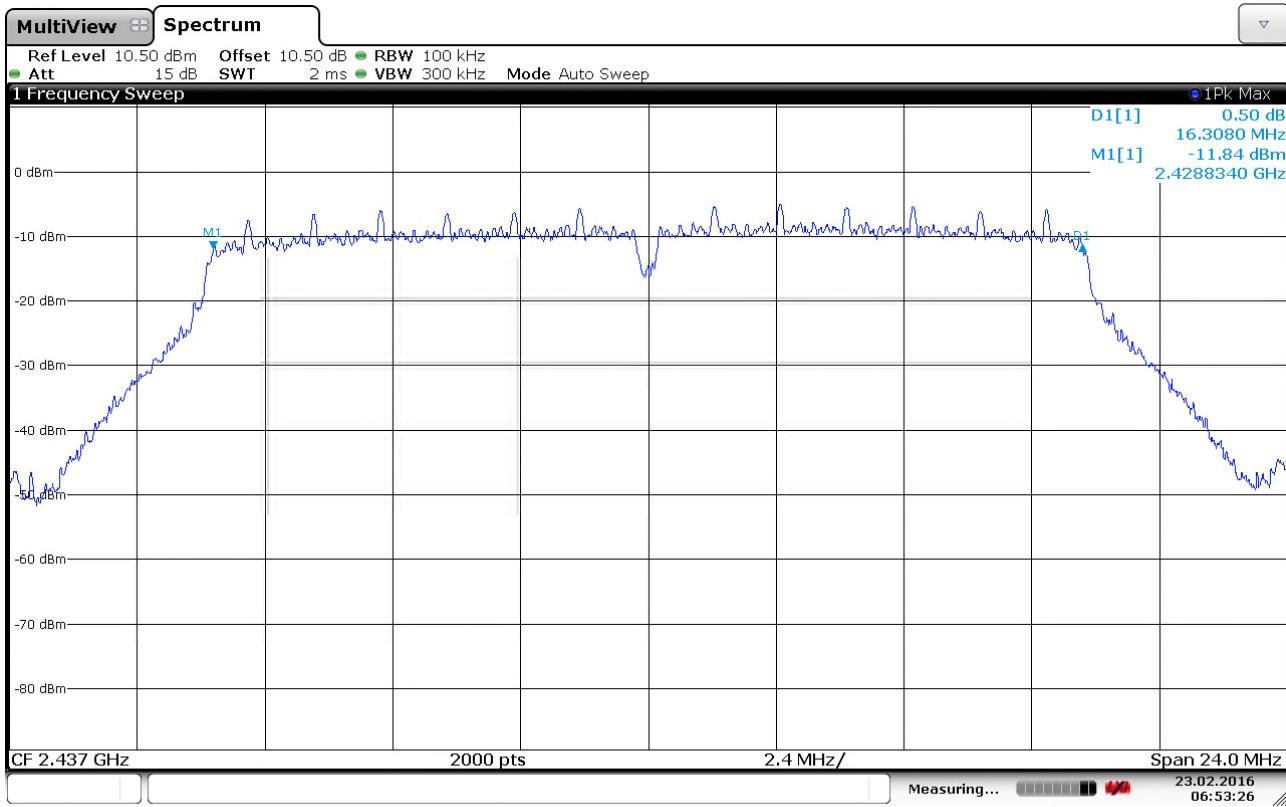
Date: 23.FEB.2016 07:02:56

6 dB Bandwidth, 2412 MHz, 802.11n, 65Mbps



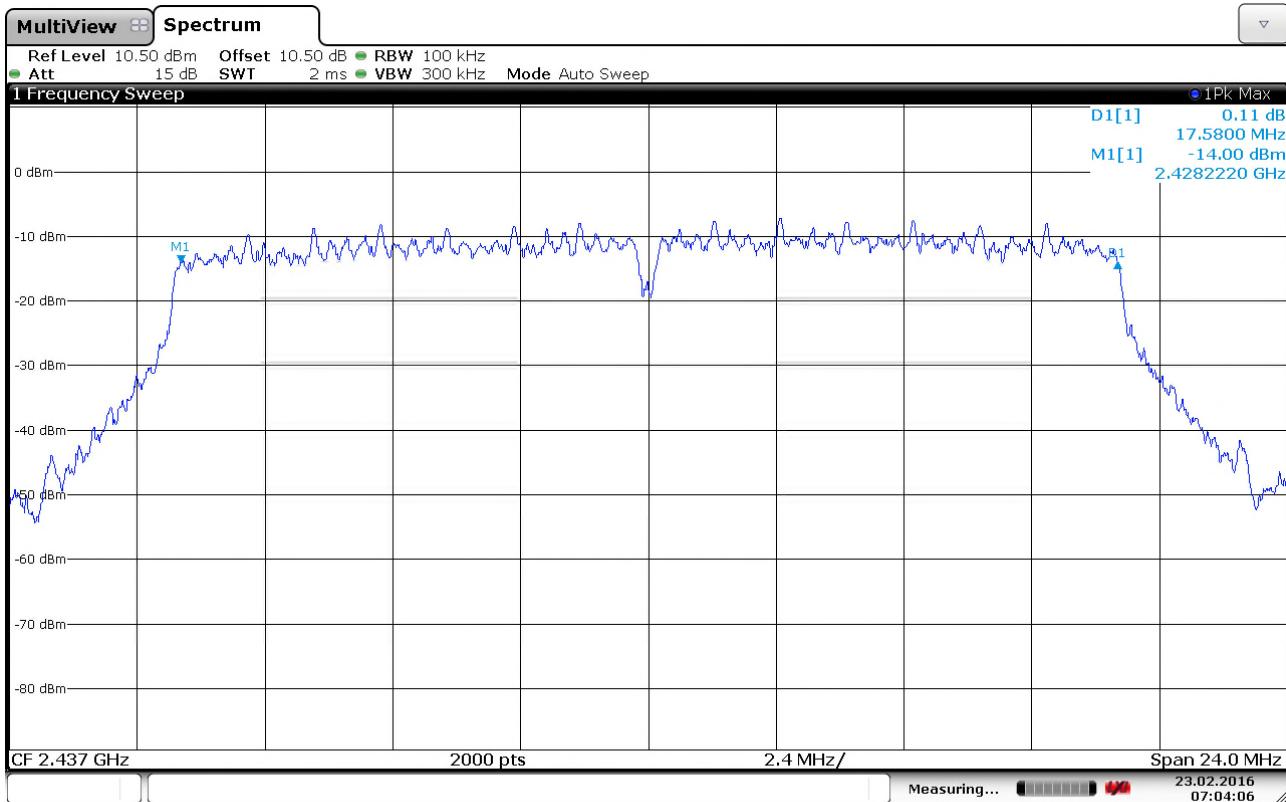
Date: 23.FEB.2016 06:59:14

6 dB Bandwidth, 2437 MHz, 802.11b, 5.5Mbps



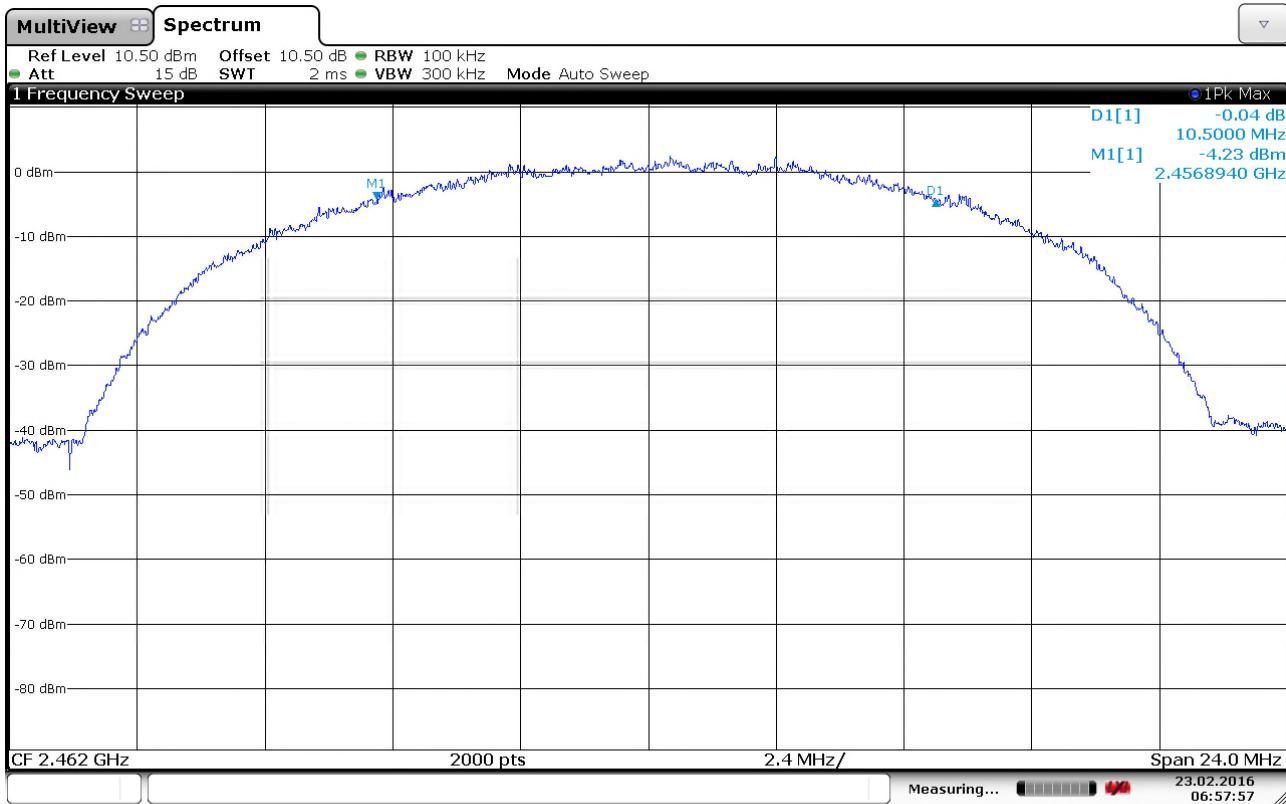
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6 dB Bandwidth, 2437 MHz, 802.11g, 9Mbps

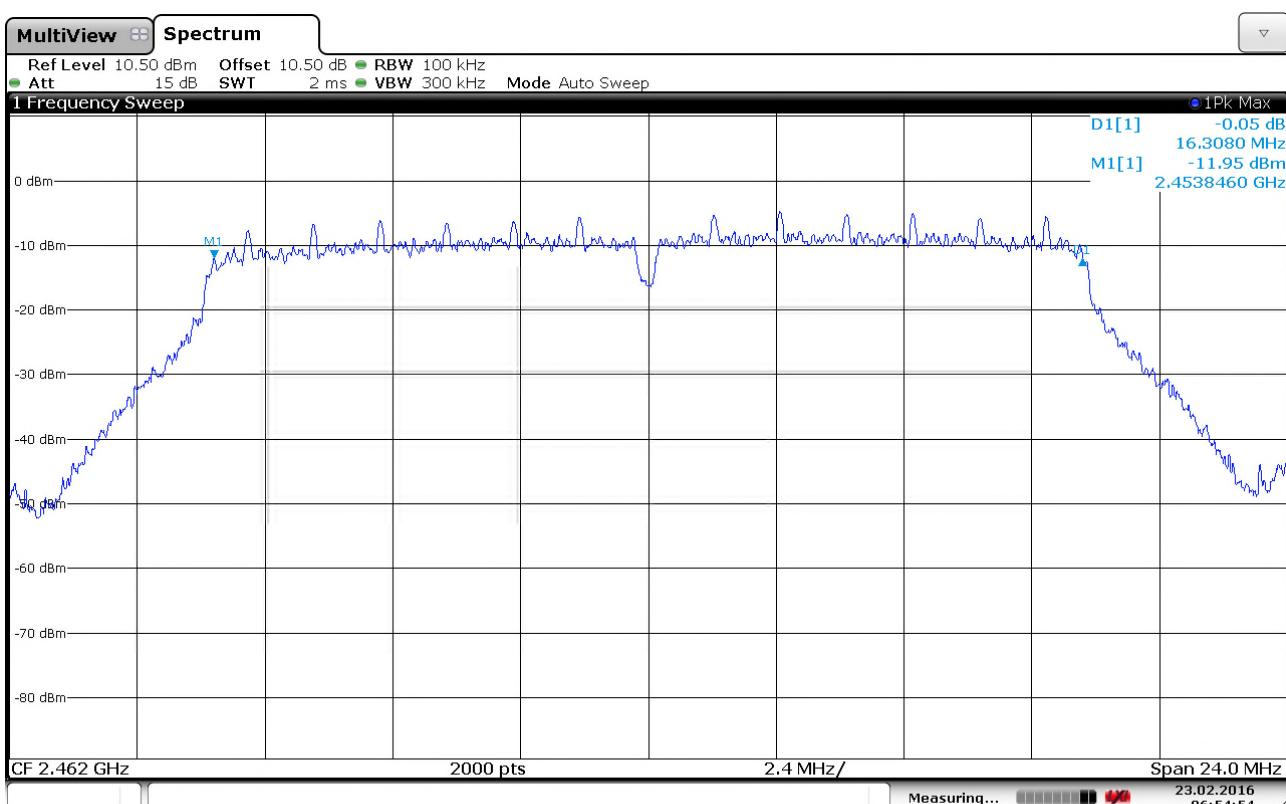


Date: 23.FEB.2016 07:04:06

6 dB Bandwidth, 2437 MHz, 802.11n, 65Mbps

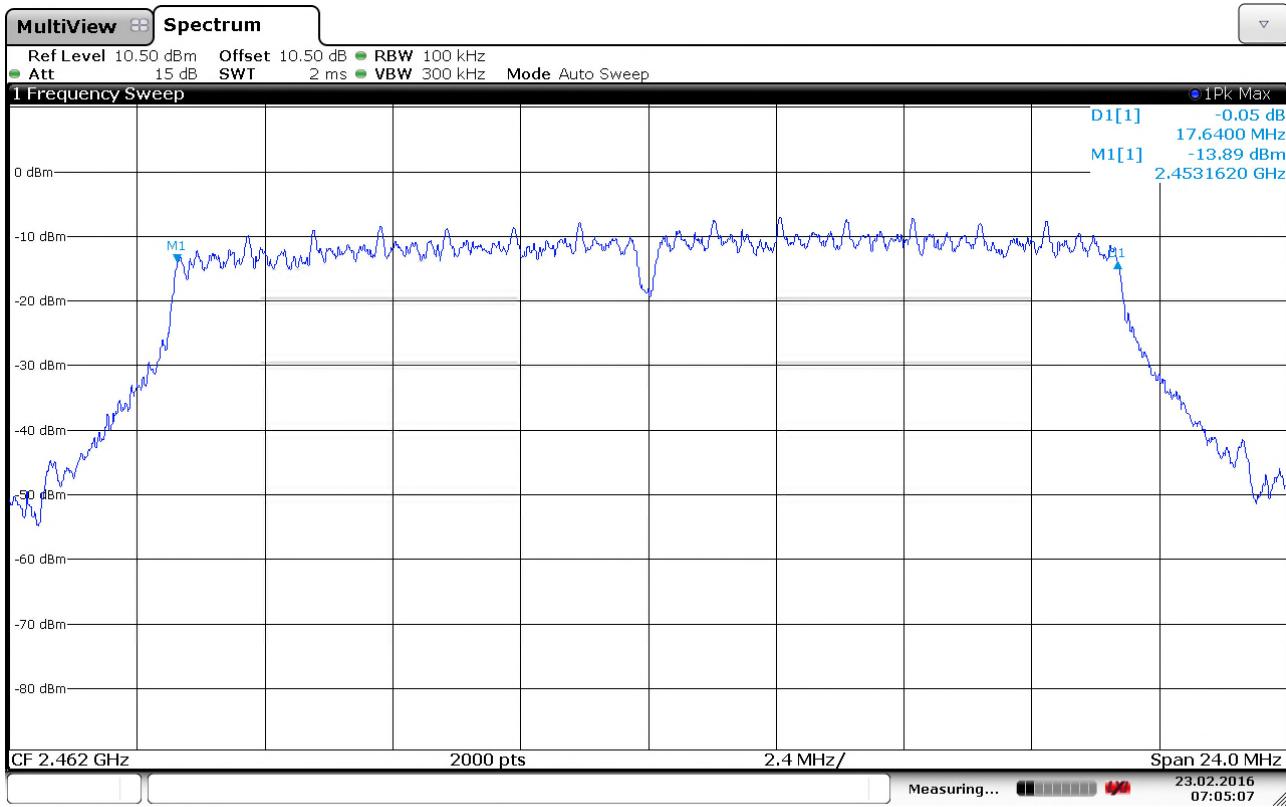


6 dB Bandwidth, 2462 MHz, 802.11b, 5.5Mbps



Date: 23.FEB.2016 06:54:54

6 dB Bandwidth, 2462 MHz, 802.11g, 9Mbps



Date: 23.FEB.2016 07:05:07

6 dB Bandwidth, 2462 MHz, 802.11n, 65Mbps



3.4 Peak Power Output

Para. No.: 15.247 (b)

Test Performed By: G.Suhanthakumar	Date of Test: 2016.02.18 – 2016.03.17
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Test Results: Complies

Measurement Data:

Carrier Frequency	Maximum Conducted Output Power, Watts		
	802.11b, 5.5 Mbps	802.11g, 9 Mbps	802.11n, 65Mbps
2412 MHz	0.033	0.024	0.014
2437 MHz	0.038	0.024	0.015
2462 MHz	0.037	0.024	0.016

Carrier Frequency	Maximum EIRP, Watts		
	802.11b, 5.5 Mbps	802.11g, 9 Mbps	802.11n, 65Mbps
2412 MHz	0.011	0.0092	0.0084
2437 MHz	0.015	0.0054	0.0083
2462 MHz	0.019	0.0053	0.0026

Carrier Frequency	Maximum Antenna Gain, dBi		
	802.11b, 5.5 Mbps	802.11g, 9 Mbps	802.11n, 65Mbps
2412 MHz	-4.77	-4.16	-2.21
2437 MHz	-4.04	-6.48	-2.27
2462 MHz	-2.89	-6.56	-7.89

Antenna gain = $10 \times \log(EIRP/\text{Conducted power})$ dBi

EIRP is calculated from measured field strength by the formulas in KDB 412172 D01 Determining ERP and EIRP v01.

The maximum field strength is obtained in XY plane and Vertical polarization.

See attached plots

Detachable antenna?

Yes No

If detachable, is the antenna connector non-standard?

Yes No

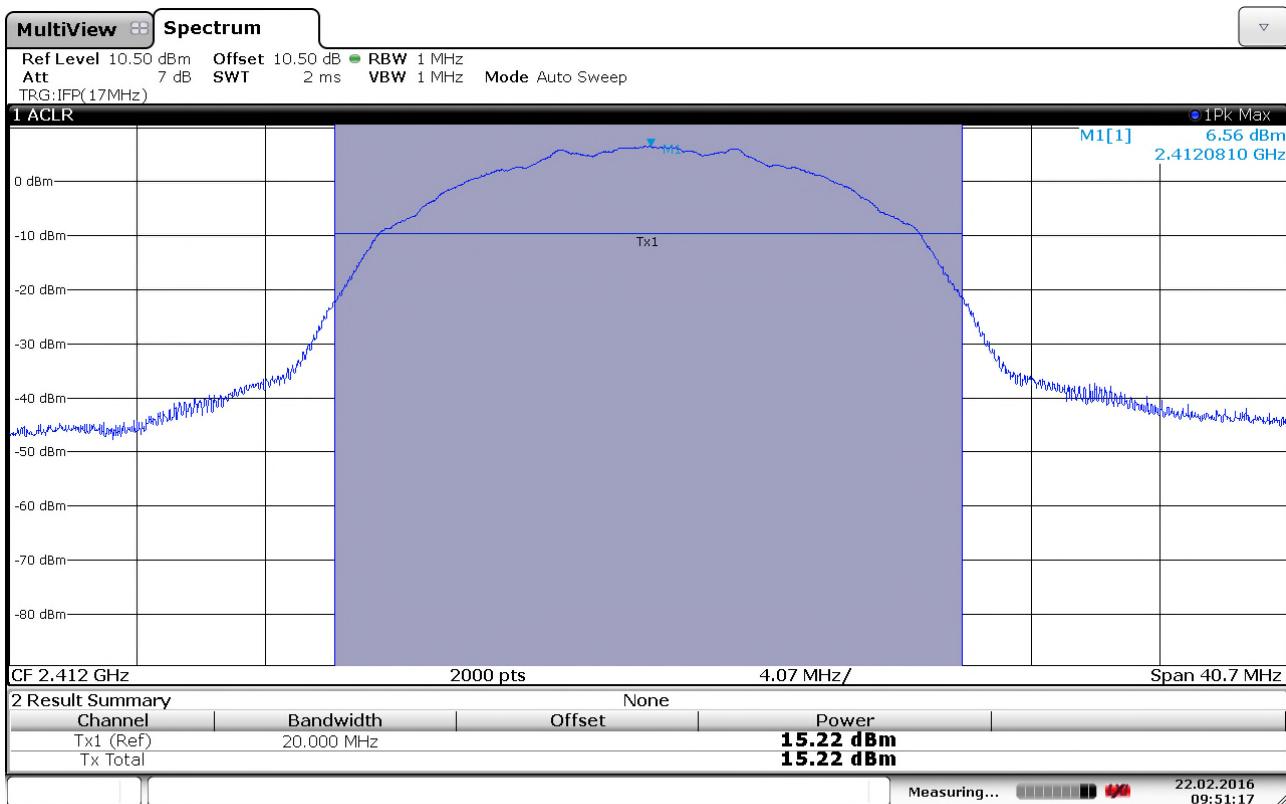
Type of antenna connector: N/A

Requirements:

The maximum peak output power shall not exceed the following limits:

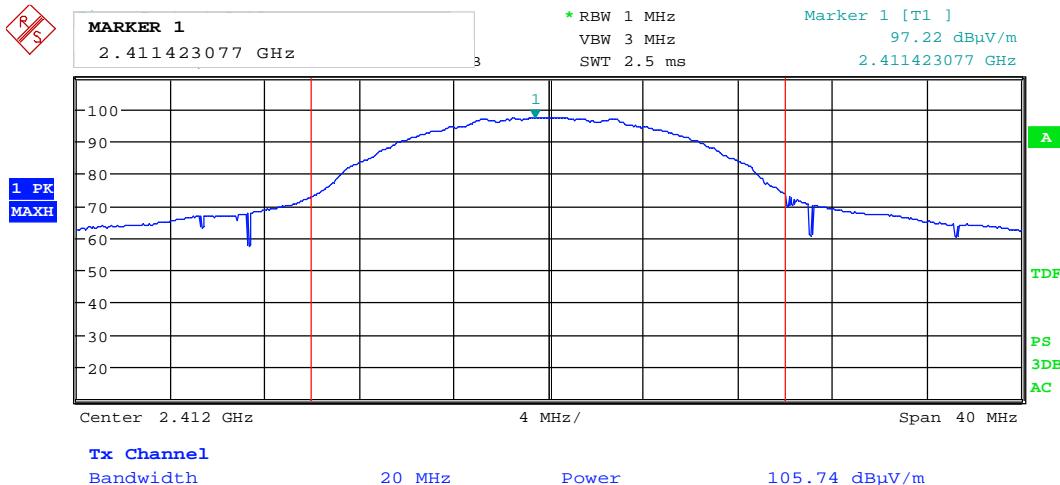
For Digital Transmission Systems in the 2400 - 2483.5 MHz band: 1 Watt

If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power from the intentional radiator shall be reduced below the stated value above by the amount in dB that the directional gain of the antenna exceeds 6 dBi.



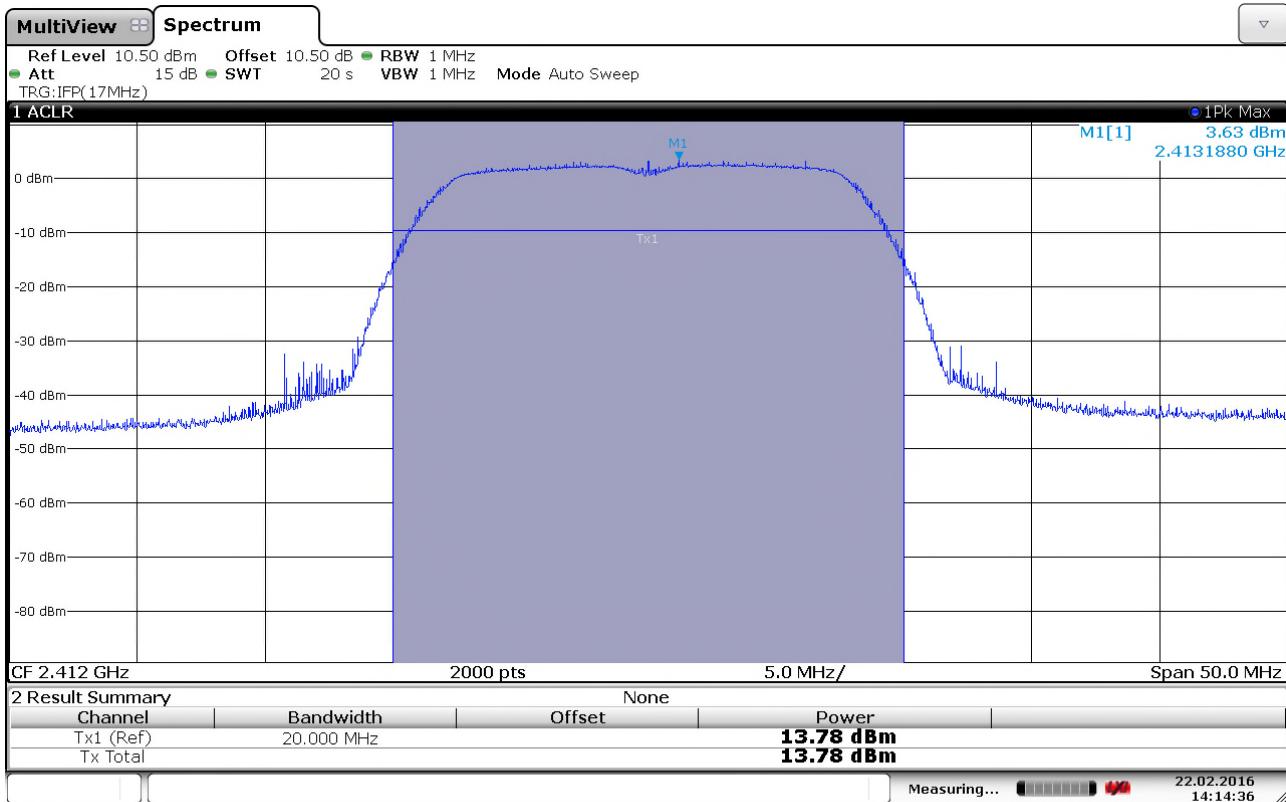
Date: 22.FEB.2016 09:51:17

Conducted Output Power, 2412 MHz, 802.11b, 5.5Mbps



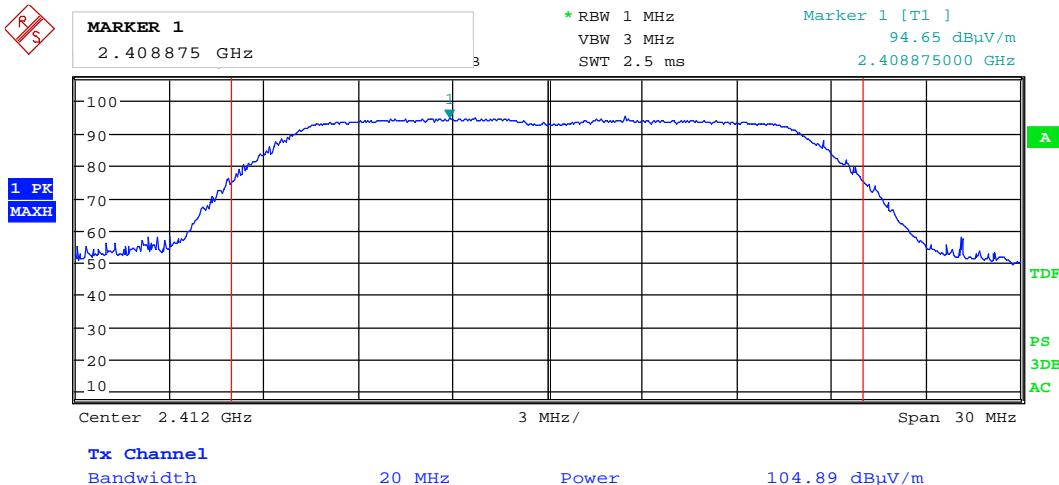
Date: 18.FEB.2016 11:08:32

Radiated Output Power, 2412 MHz, 802.11b, 5.5Mbps (Max: VP)



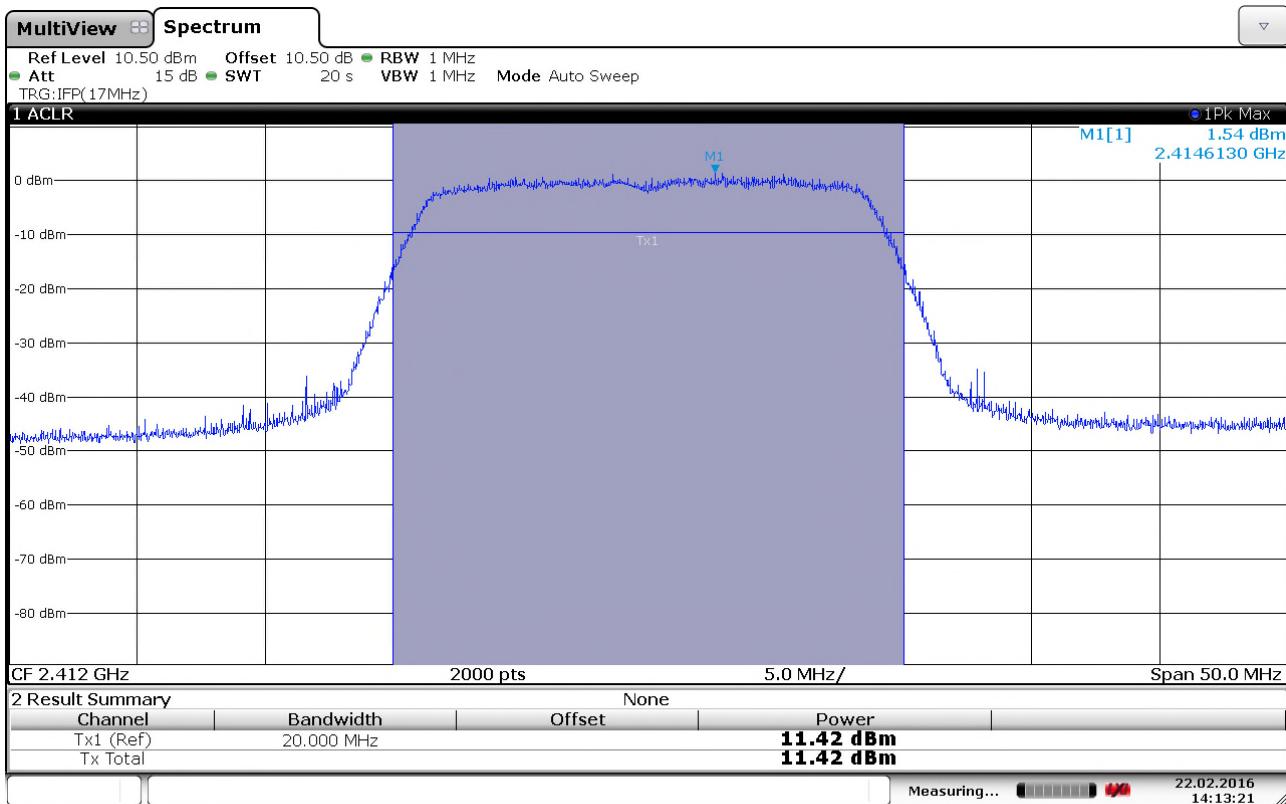
Date: 22.FEB.2016 14:14:36

Conducted Output Power, 2412 MHz, 802.11g, 9Mbps



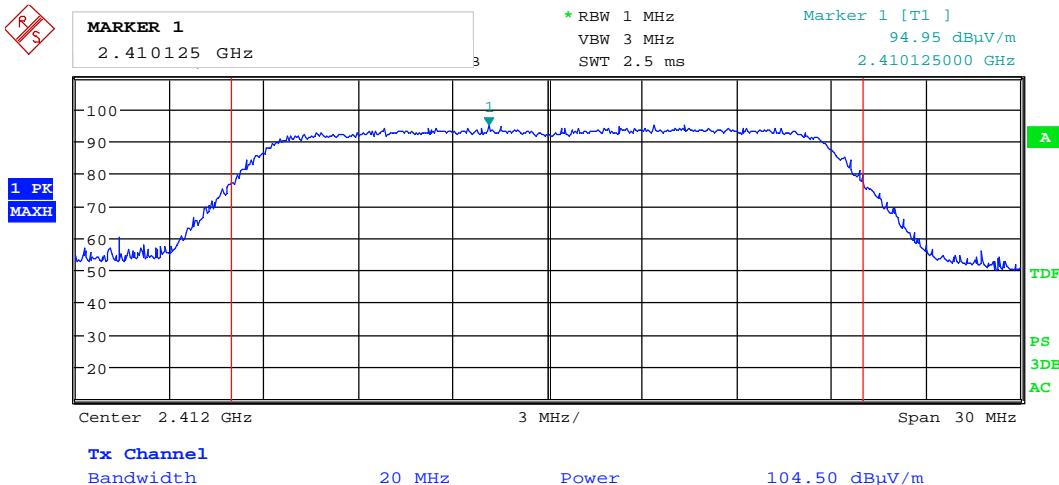
Date: 3.MAR.2016 11:18:26

Radiated Output Power, 2412 MHz, 802.11g, 9Mbps (Max: VP)



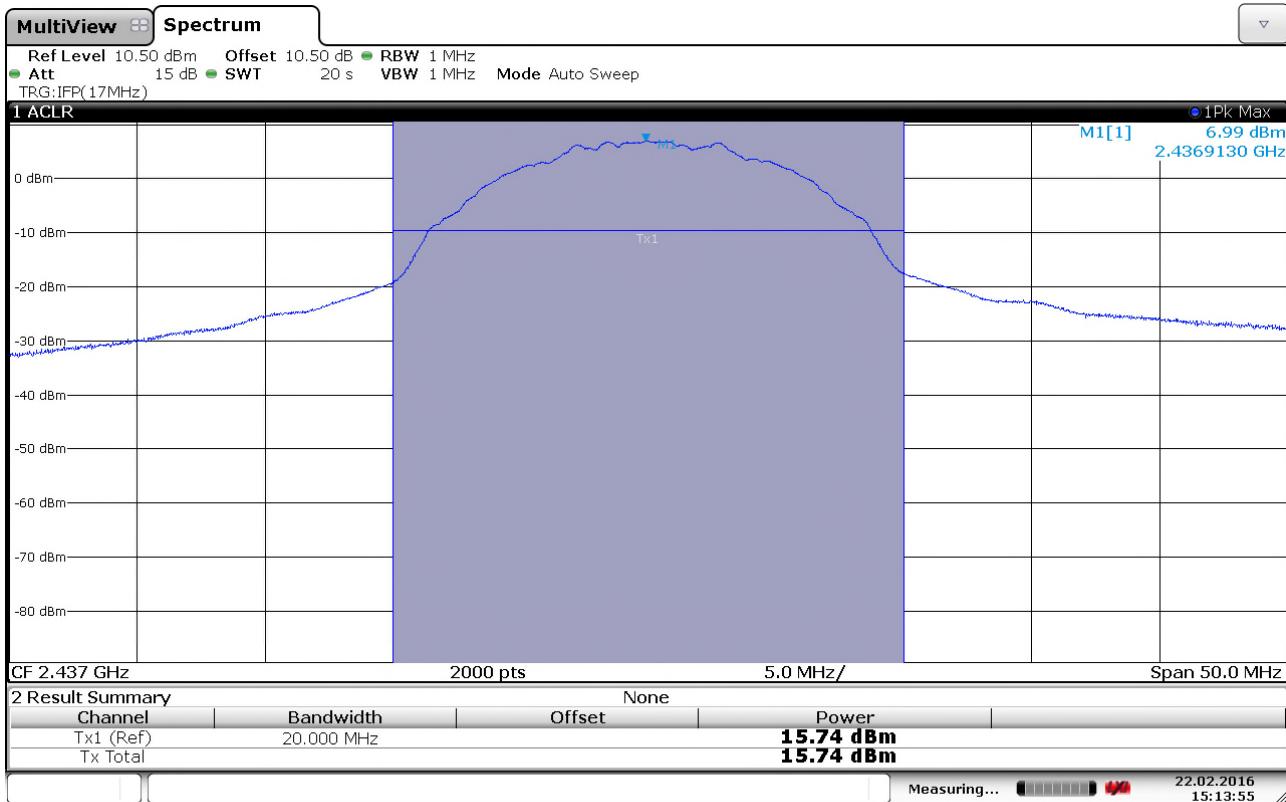
Date: 22.FEB.2016 14:13:22

Conducted Output Power, 2412 MHz, 802.11n, 65Mbps



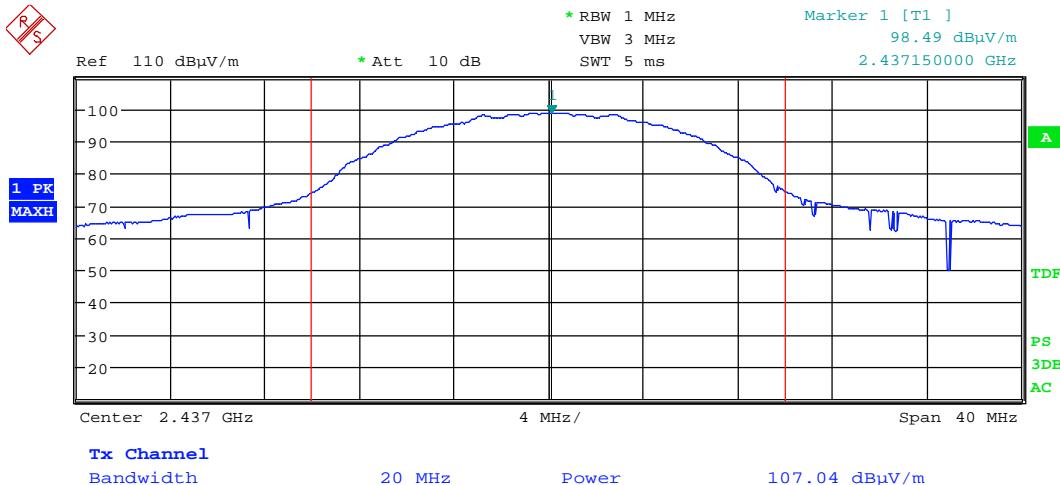
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Radiated Output Power, 2412 MHz, 802.11n, 65Mbps (Max: VP)



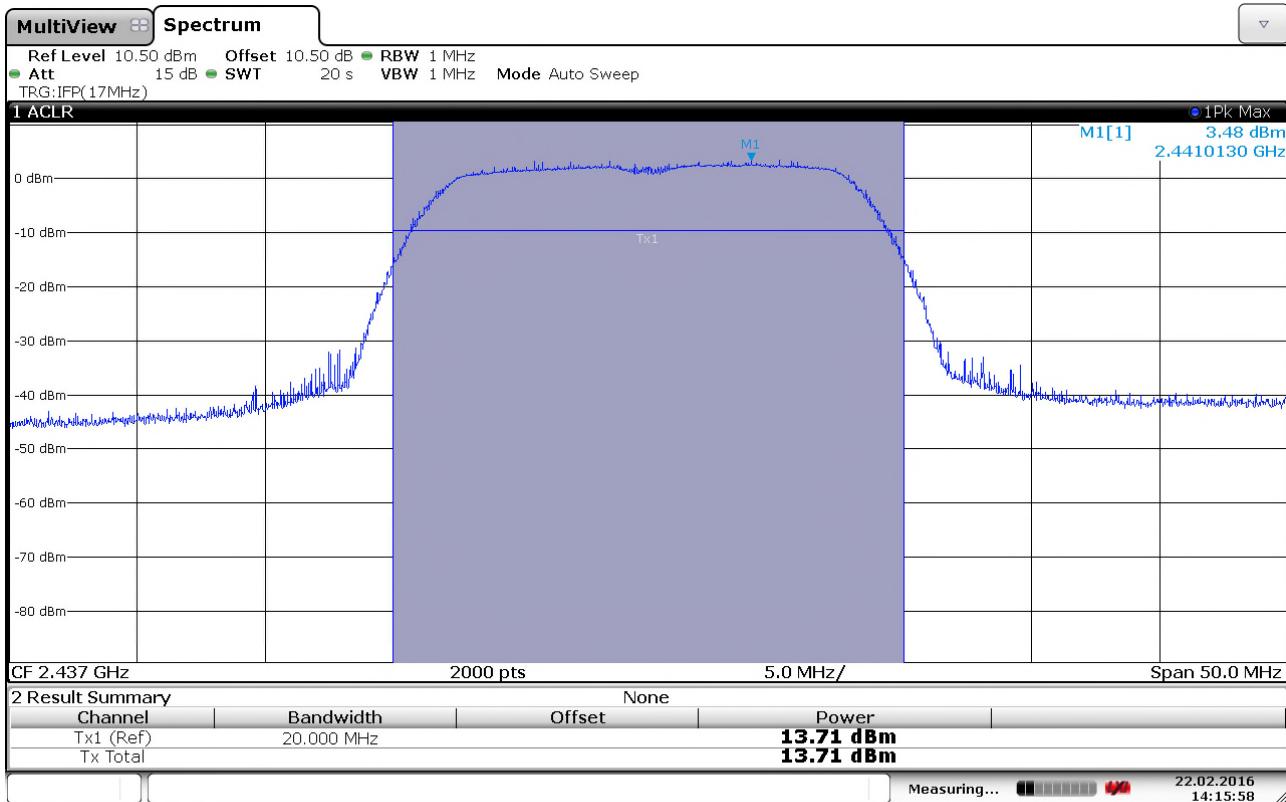
Date: 22.FEB.2016 15:13:55

Conducted Output Power, 2437 MHz, 802.11b, 5.5Mbps



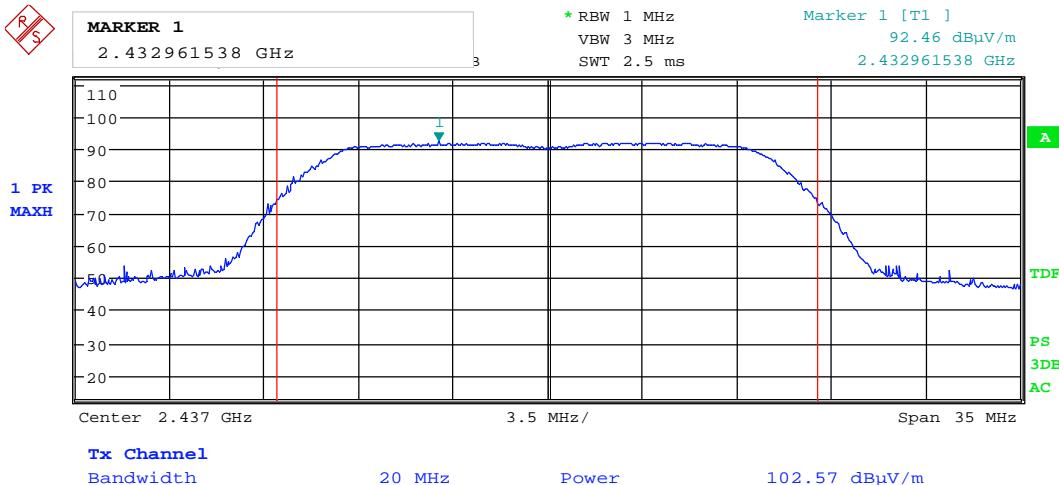
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Radiated Output Power, 2437 MHz, 802.11b, 5.5Mbps (Max: VP)



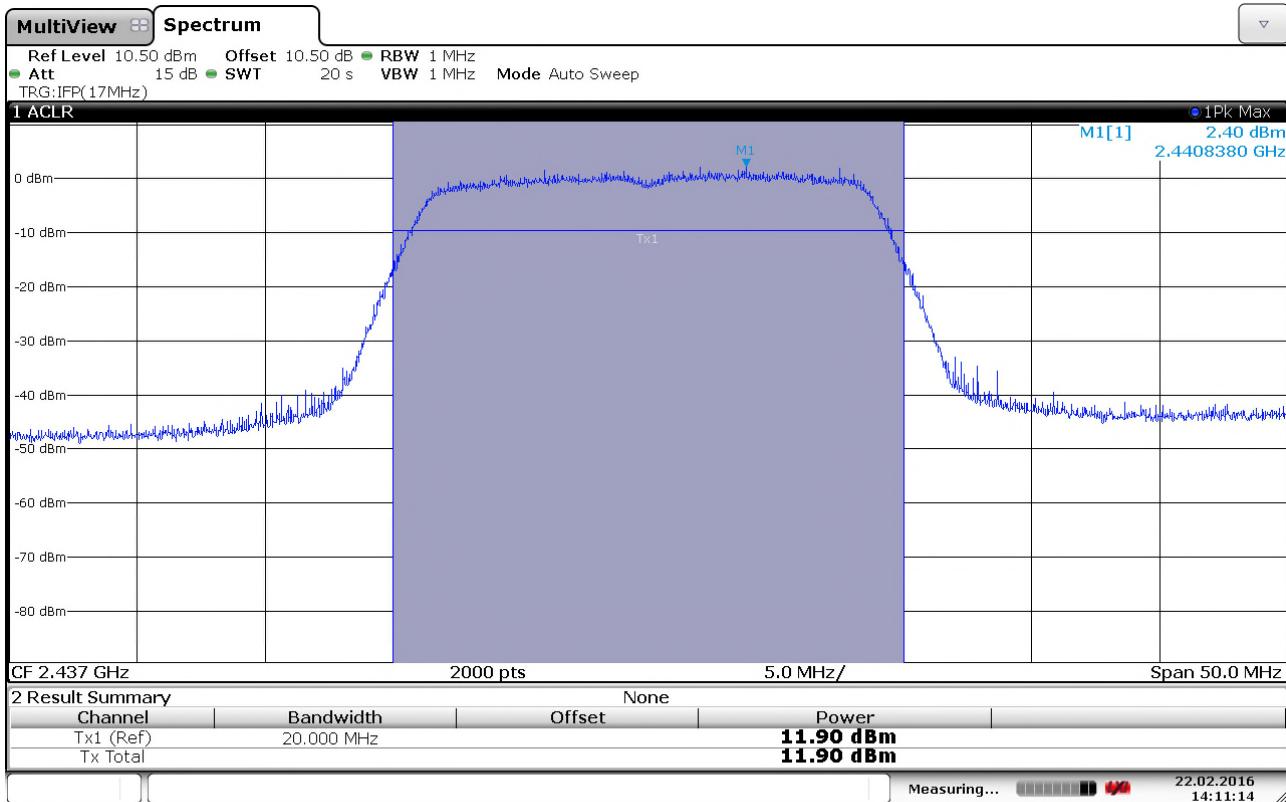
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Conducted Output Power, 2437 MHz, 802.11g, 9Mbps



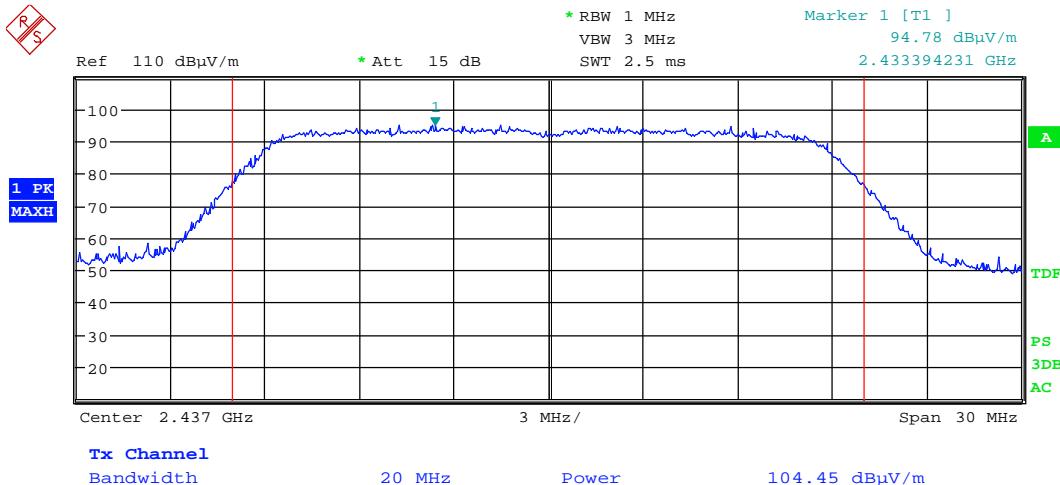
Date: 17.MAR.2016 08:23:38

Radiated Output Power, 2437 MHz, 802.11g, 9Mbps (Max: VP)



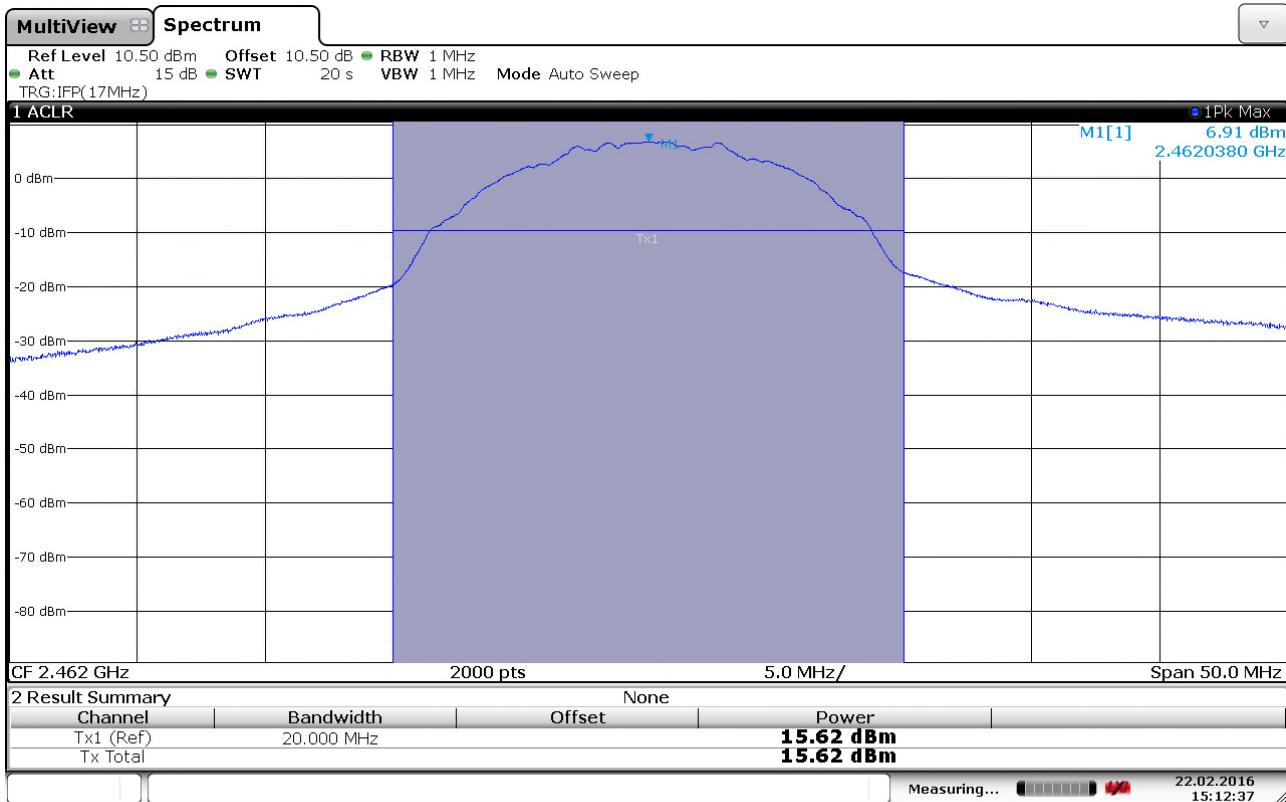
Date: 22.FEB.2016 14:11:14

Conducted Output Power, 2437 MHz, 802.11n, 65Mbps



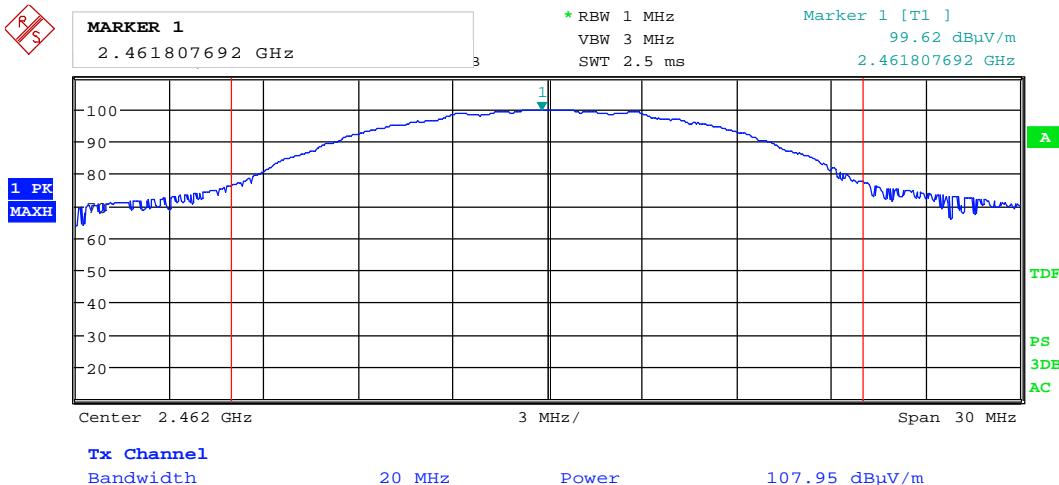
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Radiated Output Power, 2437 MHz, 802.11n, 65Mbps (Max: VP)



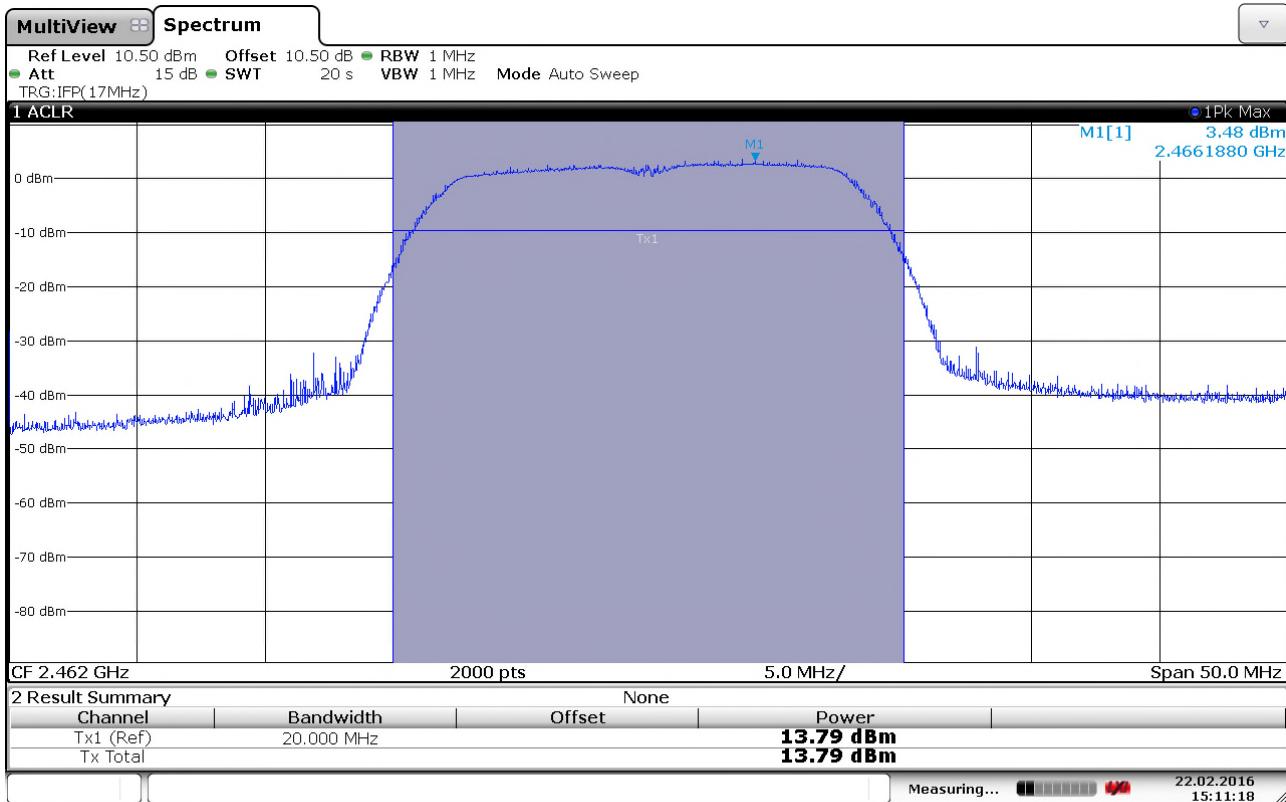
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Conducted Output Power, 2462 MHz, 802.11b, 5.5Mbps



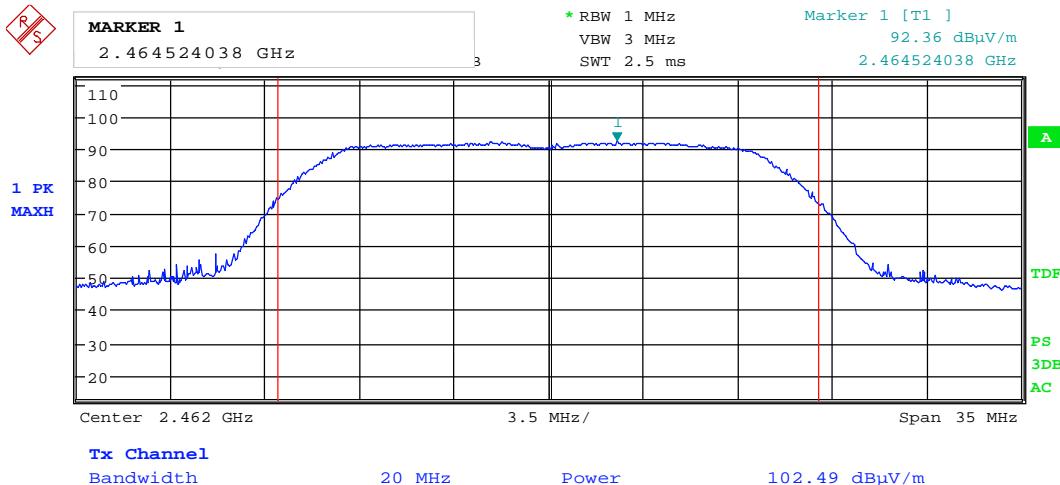
Date: 18.FEB.2016 15:59:41

Radiated Output Power, 2462 MHz, 802.11b, 5.5Mbps (Max:VP)



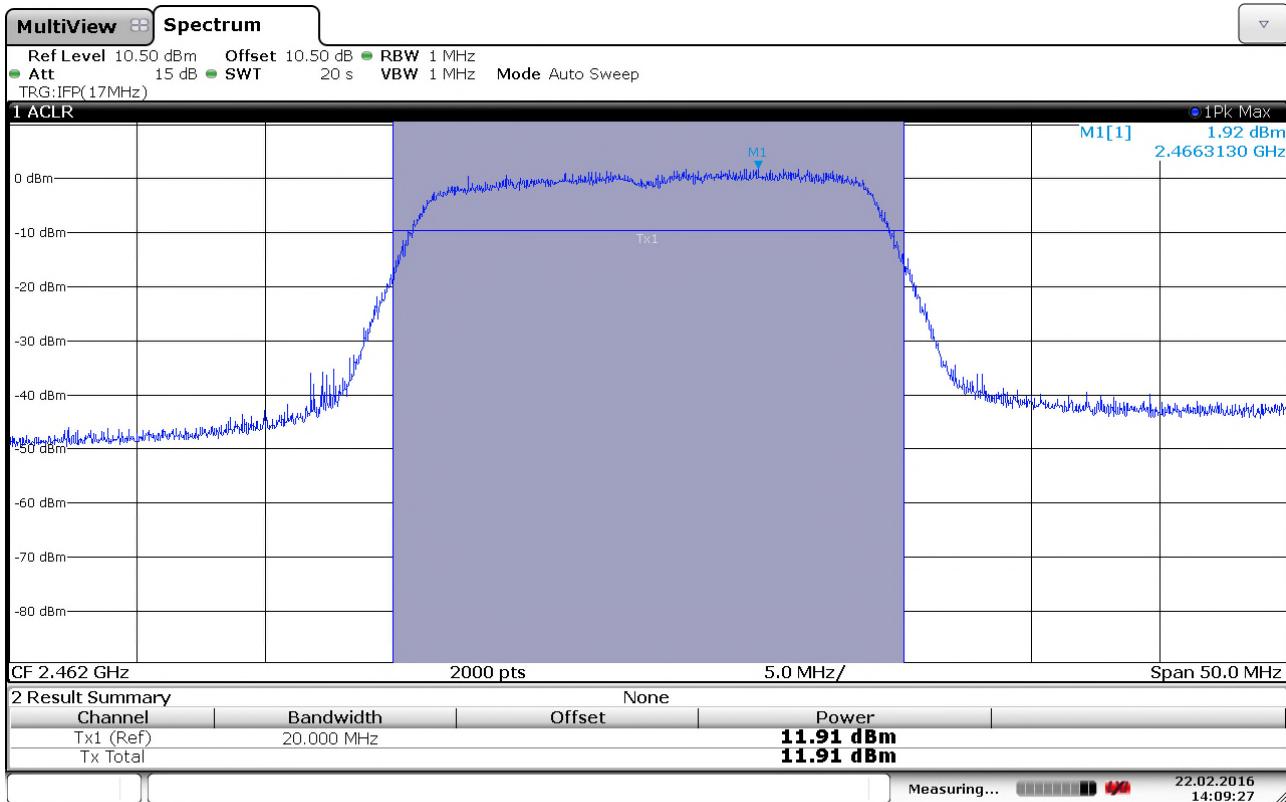
Date: 22.FEB.2016 15:11:18

Conducted Output Power, 2462 MHz, 802.11g, 9Mbps



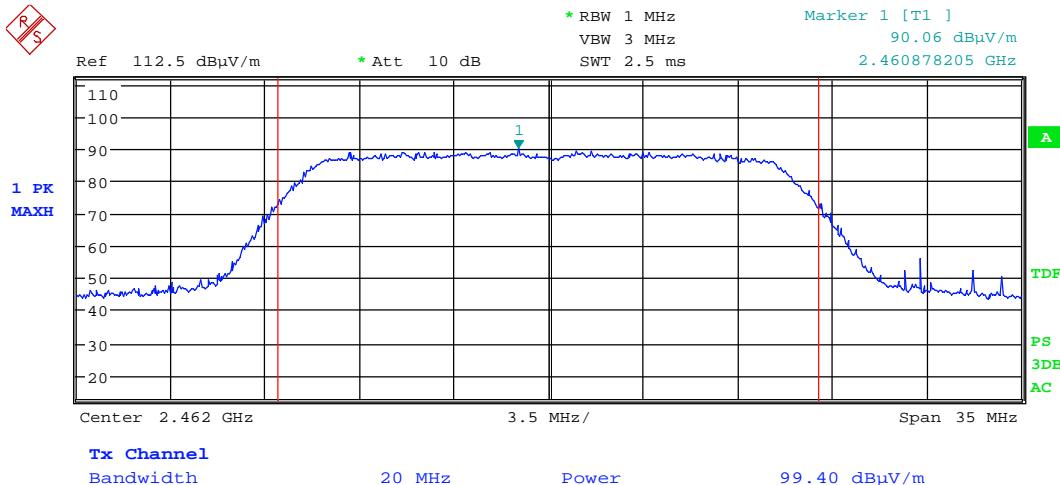
Date: 17.MAR.2016 08:31:56

Radiated Output Power, 2462 MHz, 802.11g, 9Mbps (Max:VP)



Date: 22.FEB.2016 14:09:27

Conducted Output Power, 2462 MHz, 802.11n, 65Mbps



Date: 17.MAR.2016 08:41:04

Radiated Output Power, 2462 MHz, 802.11n, 65Mbps (Max: VP)



3.5 Spurious Emissions (Radiated)

Para. No.: 15.247 (c)

Test Performed By: G.Suhanthakumar	Date of Test: 2016.03.03
------------------------------------	--------------------------

Test Results: Complies

Measurement Data:

Peak Detector:

Modulation and Bitrate	Measured field strength (dB μ V/m)		Limit	Margin	
	2390 MHz	2483.5 MHz		dB	dB
802.11b, 5.5 Mbps	61.1	54.8	74	12.9	19.2
802.11g, 9 Mbps	47.7	44.6	74	26.3	29.4
802.11n, 65Mbps	50.2	45.6	74	23.8	28.4

Average Detector:

Modulation and Bitrate	Measured field strength (dB μ V/m)		Limit	Margin	
	2390 MHz	2483.5 MHz		dB	dB
802.11b, 5.5 Mbps	48.3	52.6	54	5.7	1.4
802.11g, 9 Mbps	44.5	44.3	54	9.5	9.7
802.11n, 65Mbps	53.9	51.5	54	0.1	2.5

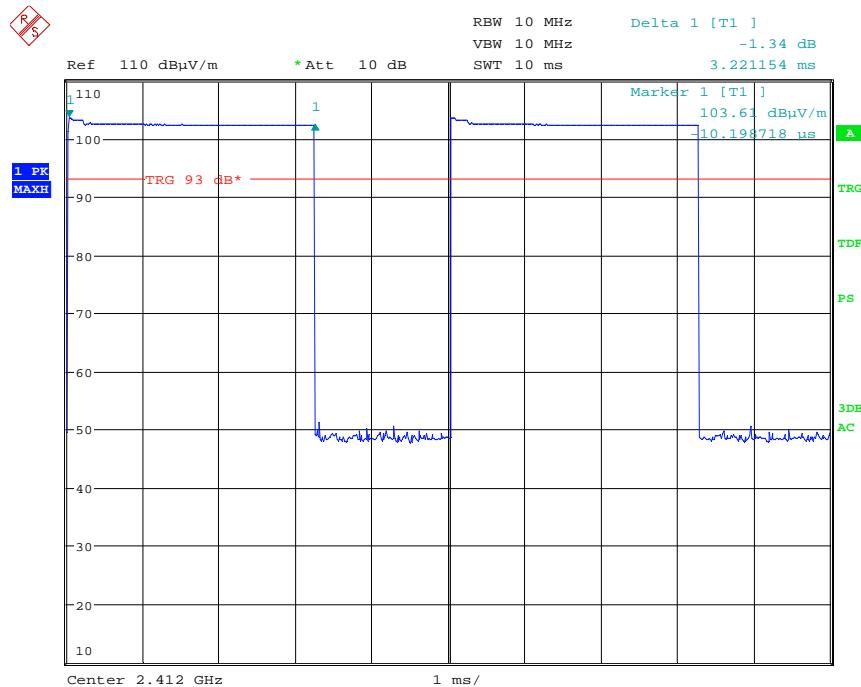
Duty cycle:

	Duty cycle (x) %	Duty cycle correction (dB)
802.11b, 5.5Mbps	64.02	1.93
802.11g, 9Mbps	95.32	0.20
802.11n, 65Mbps	5.74	12.4

Duty cycle: $10\log(1/x)$

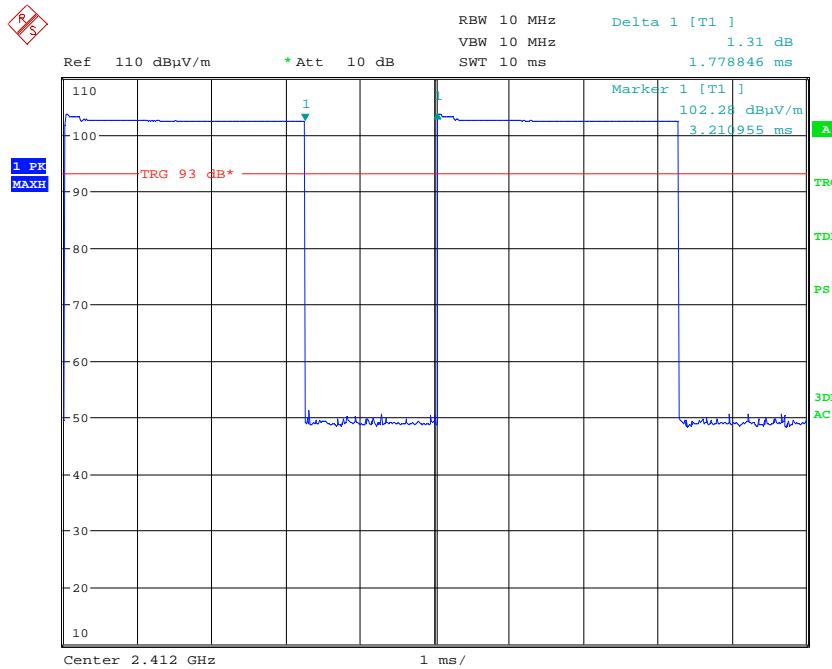
Average values are measured with RMS Detector and corrected for Duty Cycle.

See attached plots



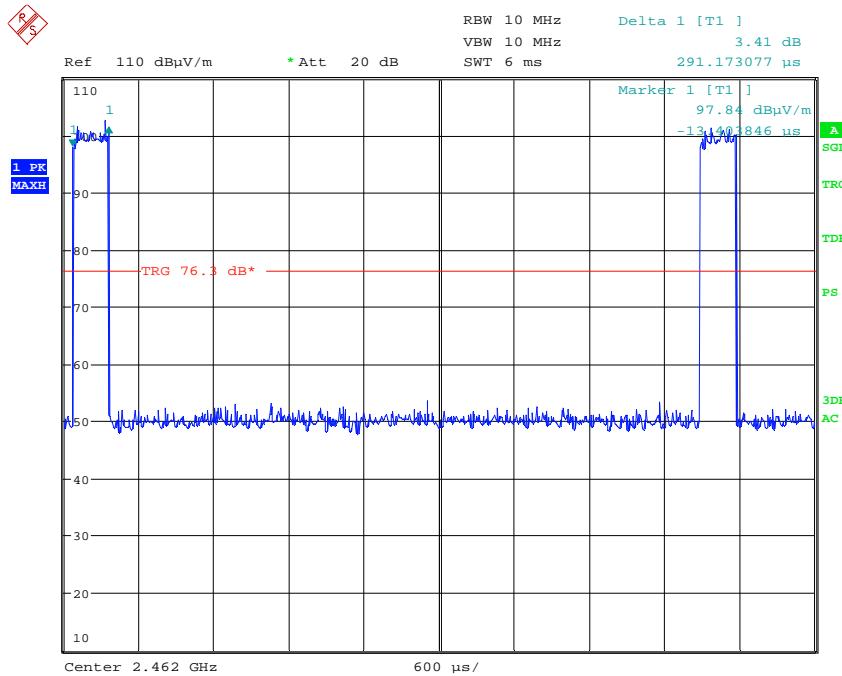
Date: 18.FEB.2016 11:22:09

ON time – 11b , 5.5Mbps



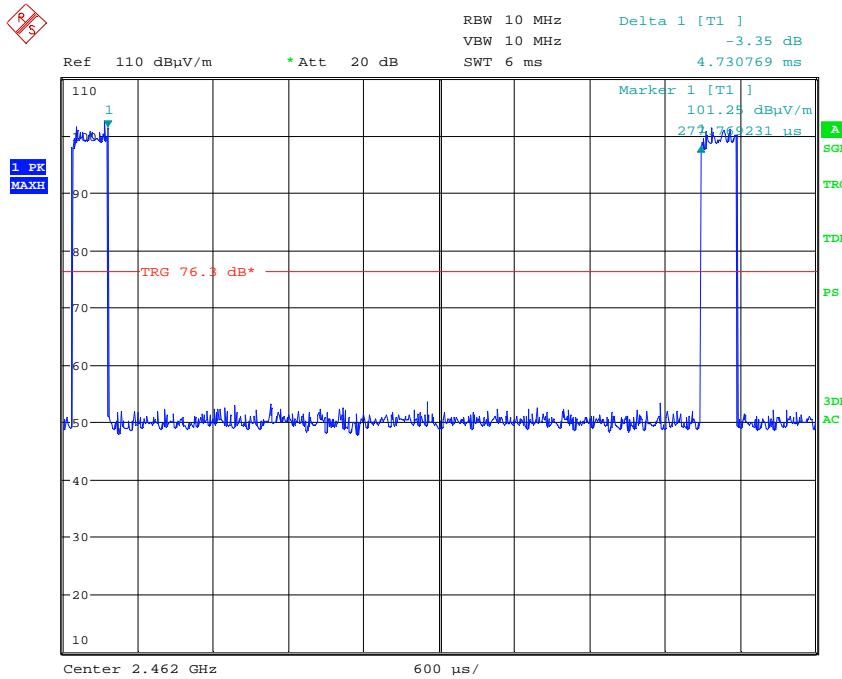
Date: 18.FEB.2016 11:22:36

OFF time – 11b , 5.5Mbps



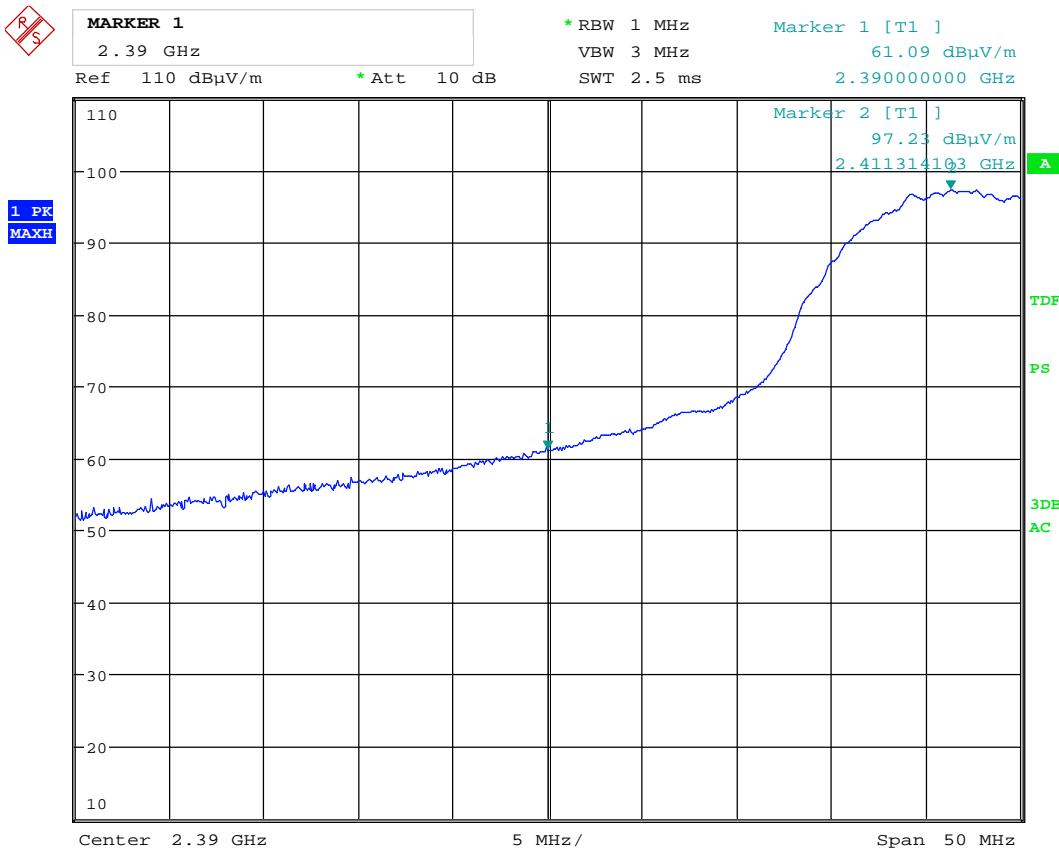
Date: 19.FEB.2016 08:07:27

ON time- 11n, 65Mbps



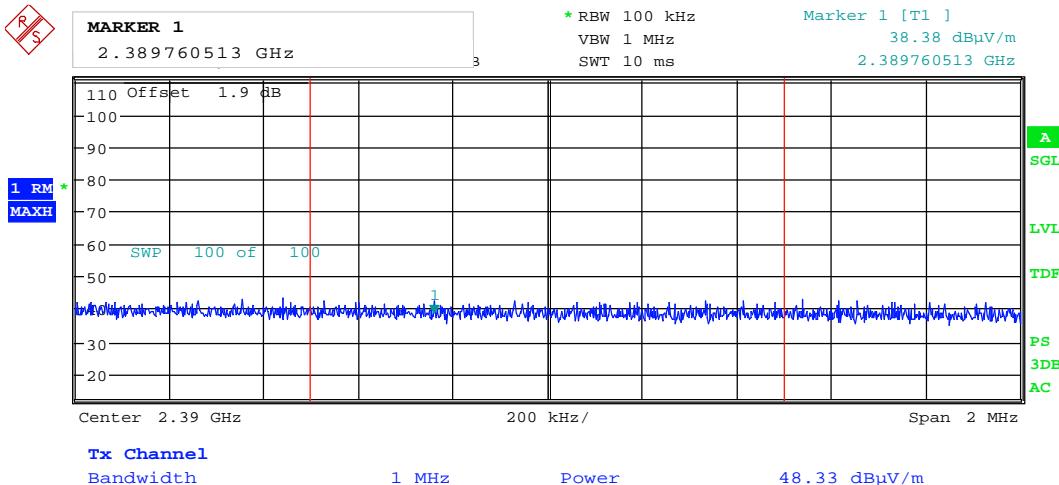
Date: 19.FEB.2016 08:08:22

OFF time- 11n, 65Mbps



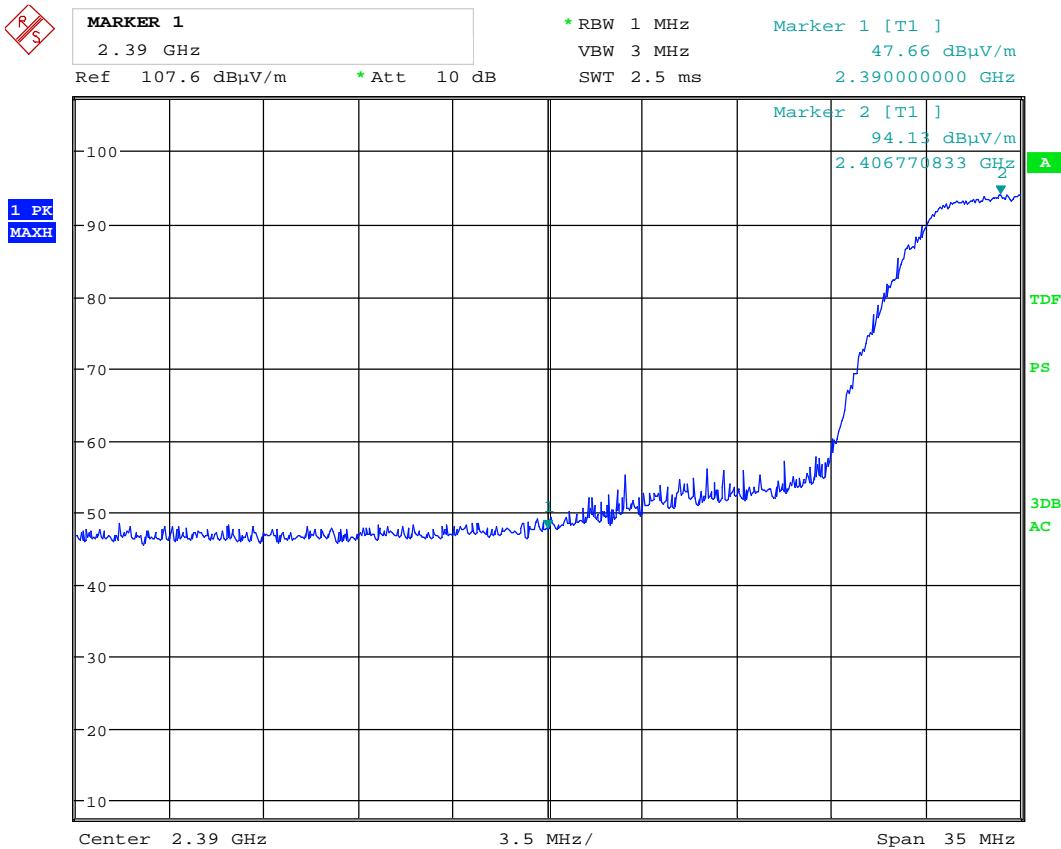
Date: 18.FEB.2016 11:15:55

Band Edge, Lower, Peak, 2412 MHz, 802.11b, 5.5Mbps



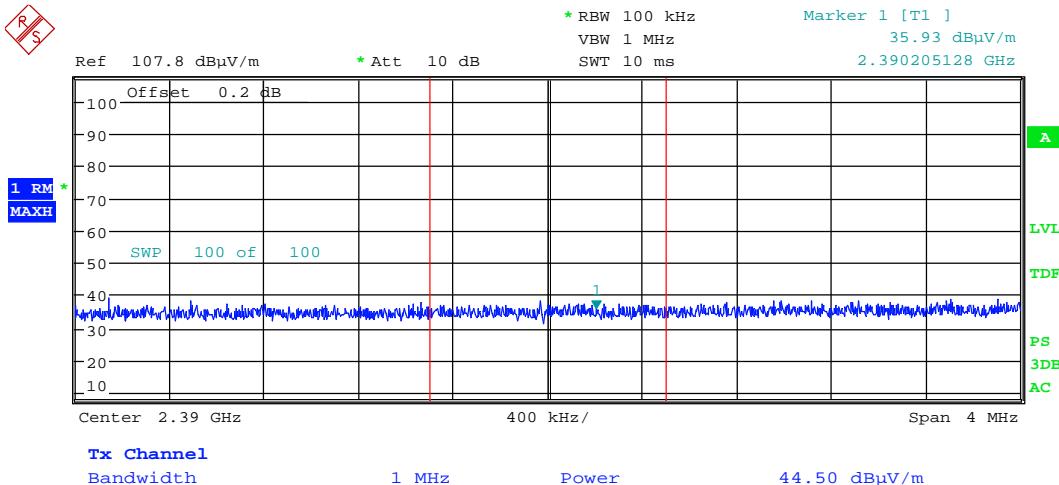
Date: 18.FEB.2016 12:49:05

Band Edge, Lower, Average, 2412 MHz, 802.11b, 5.5Mbps



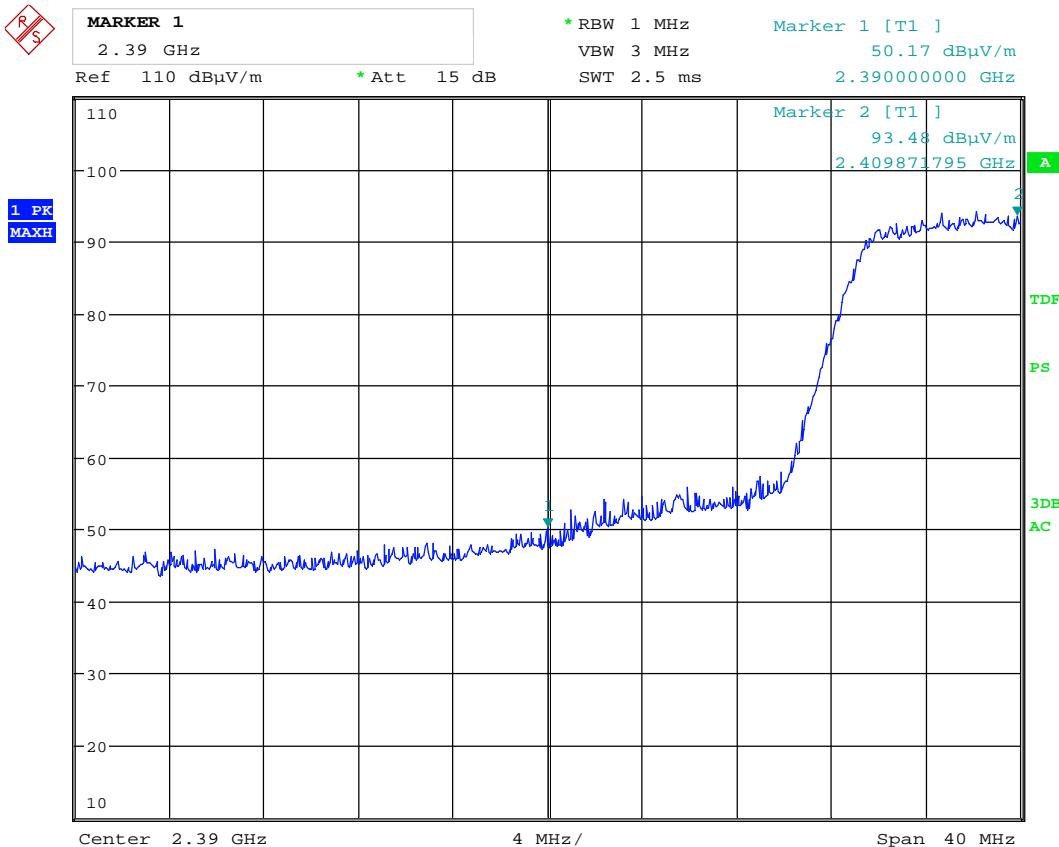
Date: 3.MAR.2016 11:19:06

Band Edge, Lower, Peak, 2412 MHz, 802.11g, 9Mbps



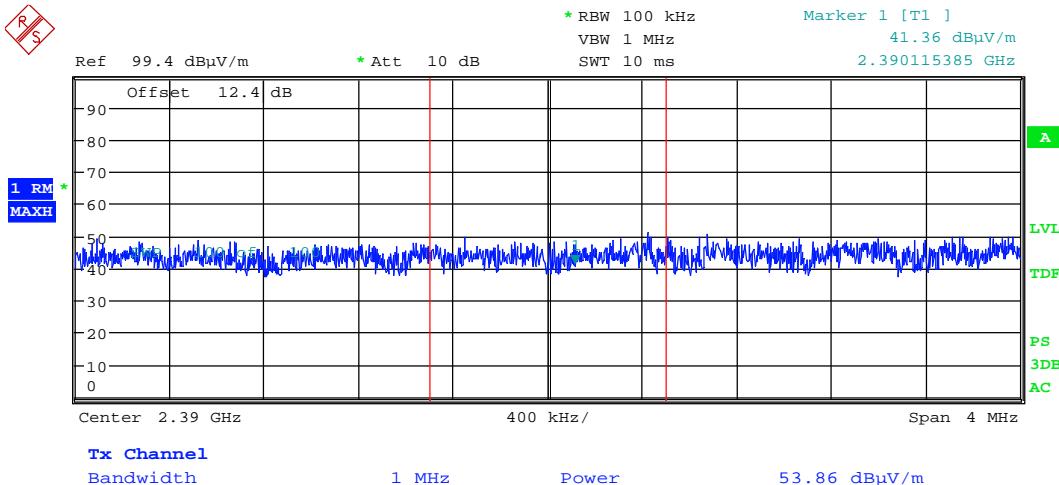
Date: 3.MAR.2016 11:54:15

Band Edge, Lower, Average, 2412 MHz, 802.11g, 9Mbps



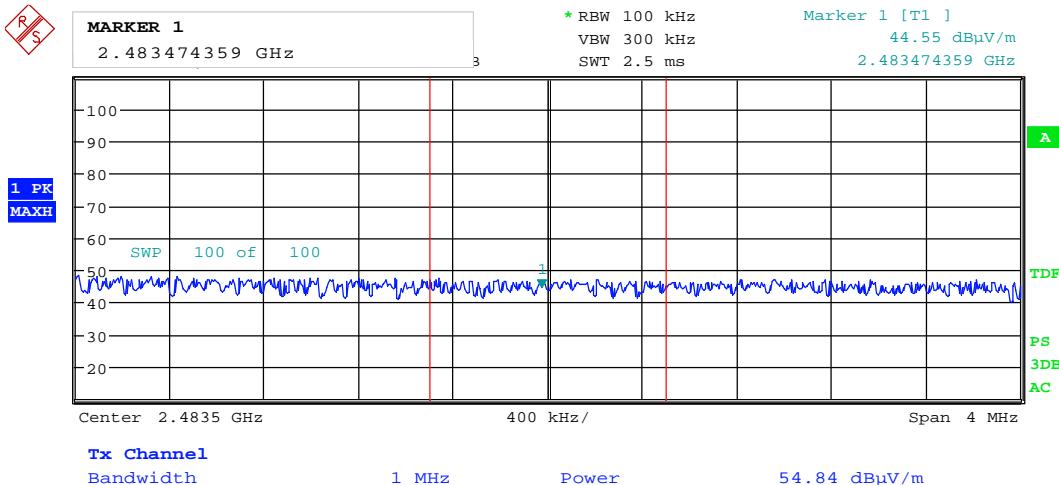
Date: 3.MAR.2016 09:28:23

Band Edge, Lower, Peak, 2412 MHz, 802.11n, 65Mbps



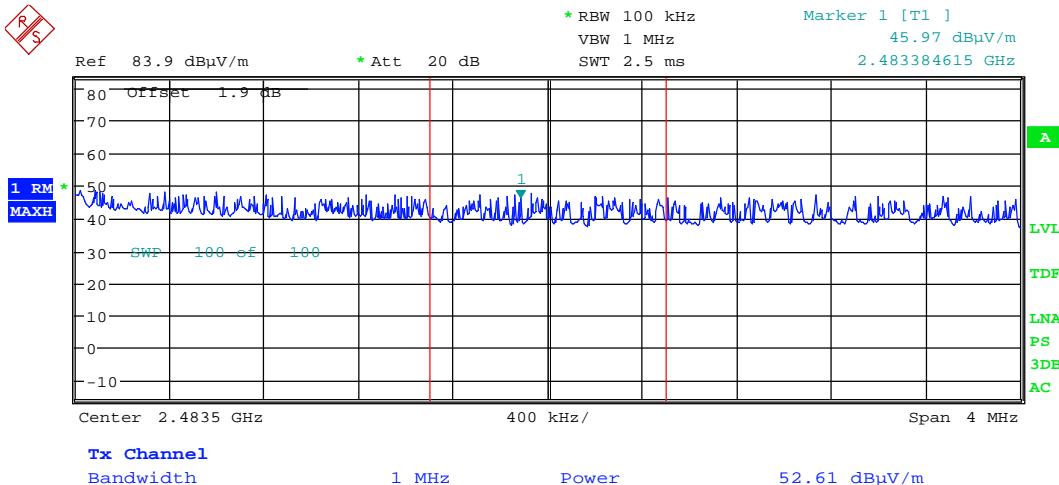
Date: 3.MAR.2016 09:34:15

Band Edge, Lower, Average, 2412 MHz, 802.11n, 65Mbps



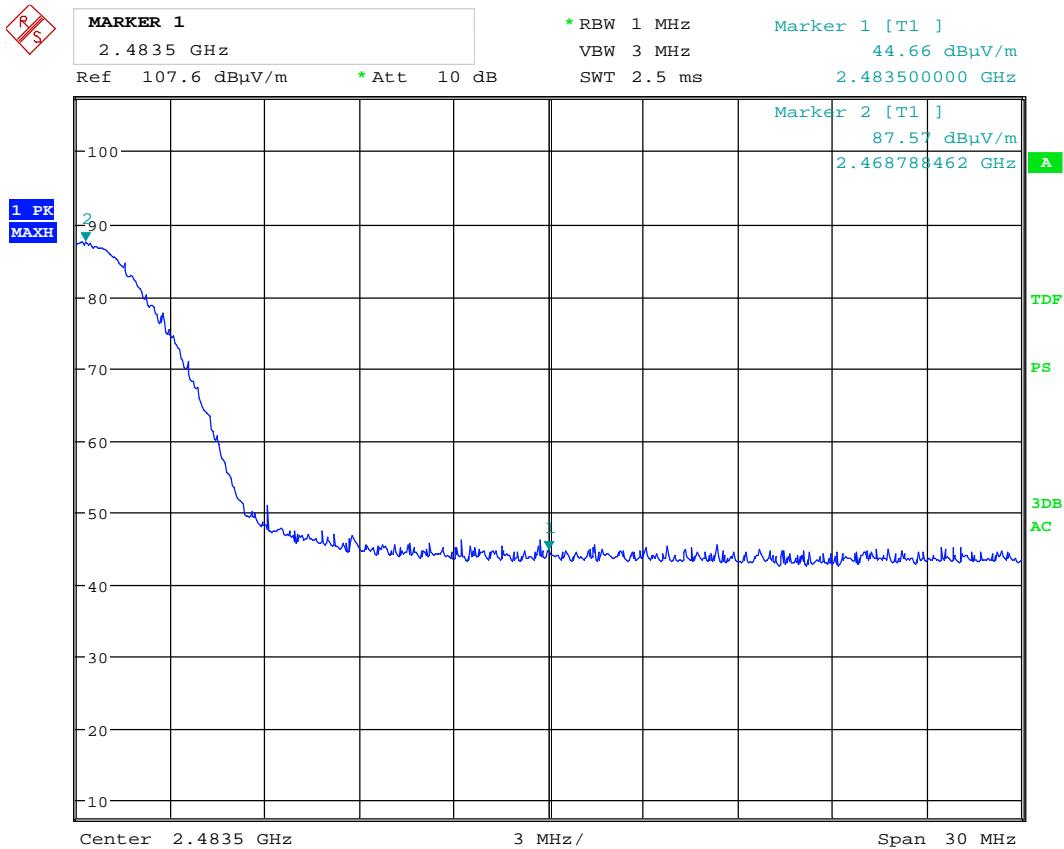
Date: 18.FEB.2016 16:03:32

Band Edge, Upper, Peak, 2462 MHz, 802.11b, 5.5Mbps



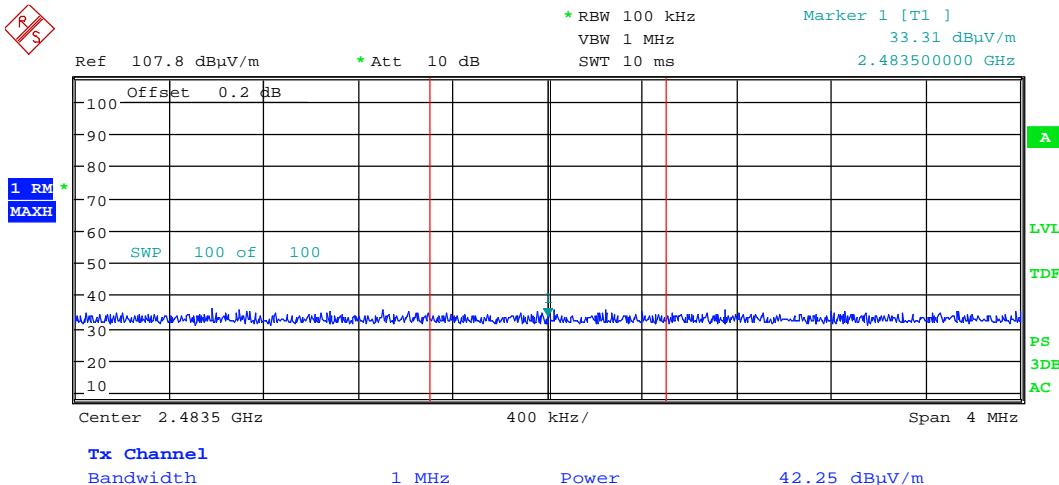
Date: 18.FEB.2016 16:07:05

Band Edge, Upper, Average, 2462 MHz, 802.11b, 5.5Mbps



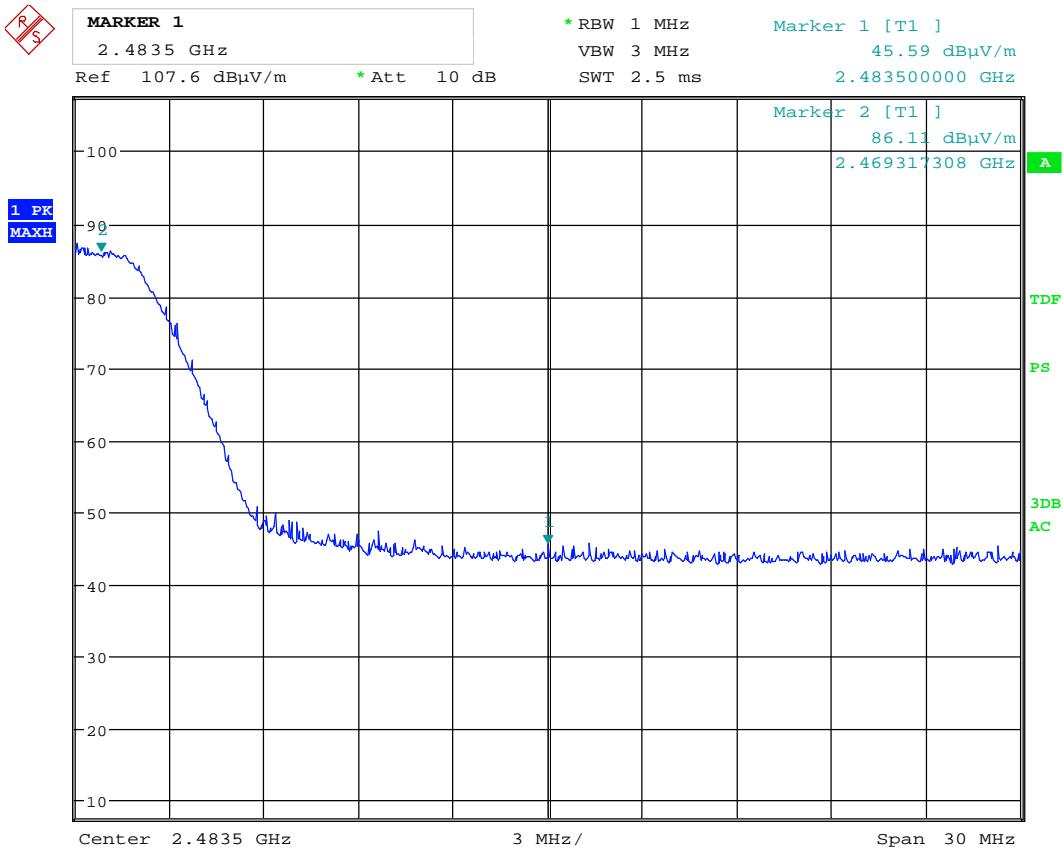
Date: 3.MAR.2016 11:05:48

Band Edge, Upper, Peak, 2462 MHz, 802.11g, 9Mbps



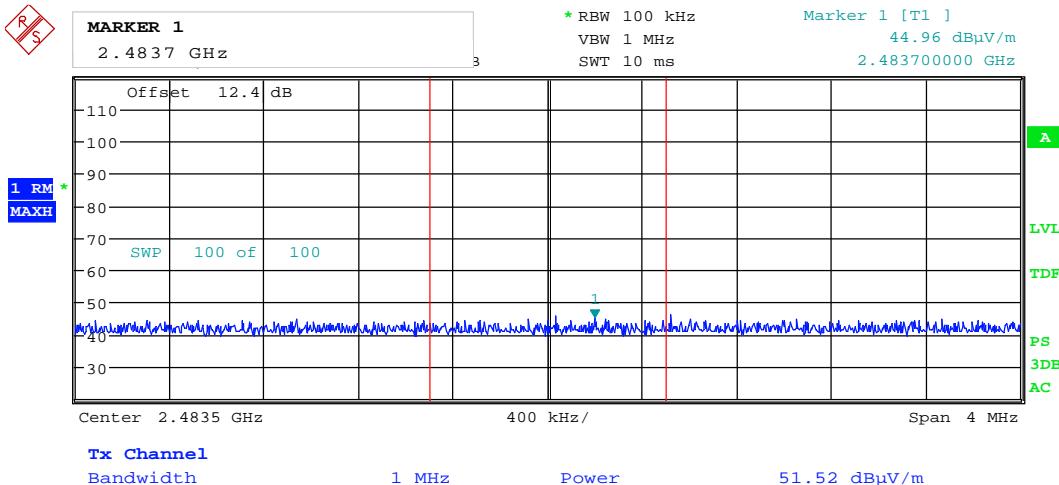
Date: 3.MAR.2016 11:04:38

Band Edge, Upper, Average, 2462 MHz, 802.11g, 9Mbps



Date: 3.MAR.2016 10:53:29

Band Edge, Upper, Peak, 2462 MHz, 802.11n, 65Mbps



Date: 3.MAR.2016 10:41:42

Band Edge, Upper, Average, 2462 MHz, 802.11n, 65Mbps

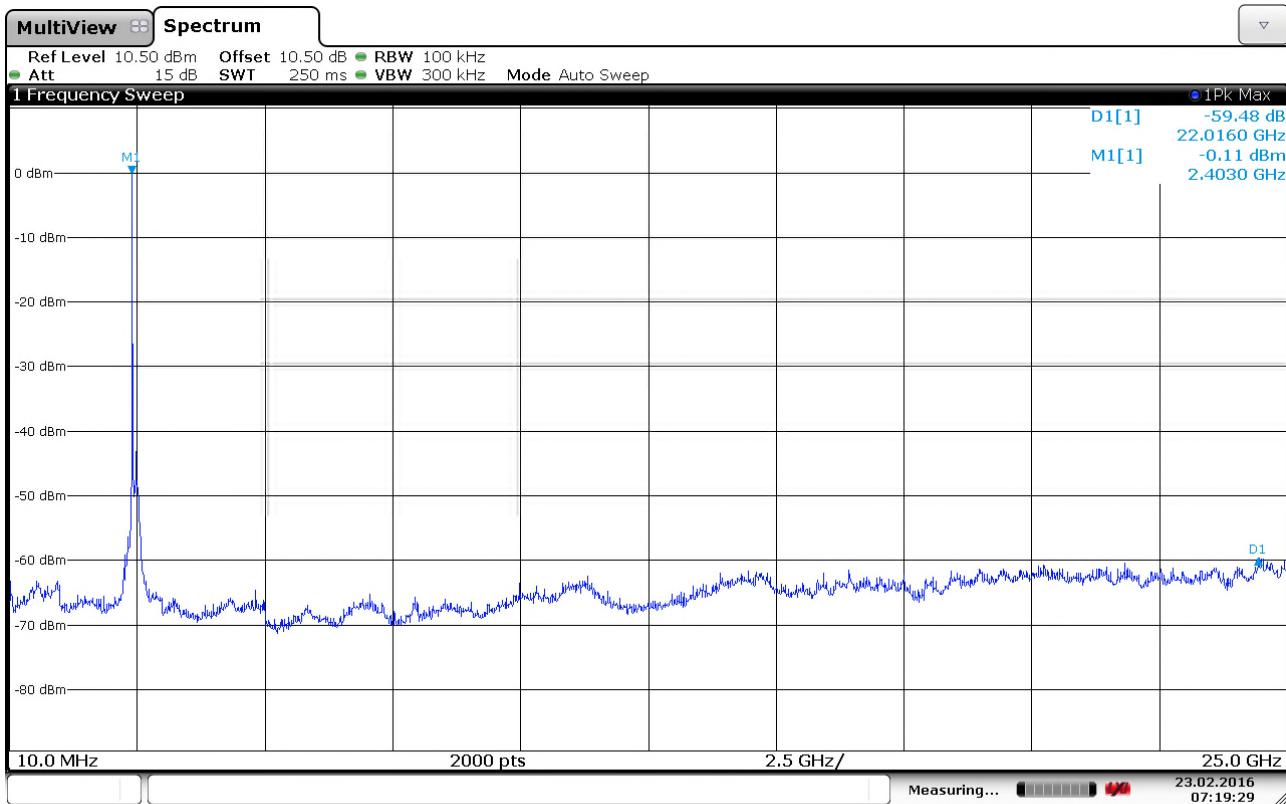
RF conducted power to 25 GHz see attached graph.

Maximum RF level outside operating band:

RF ch 2412 MHz: >30 dB/C, margin >30 dB

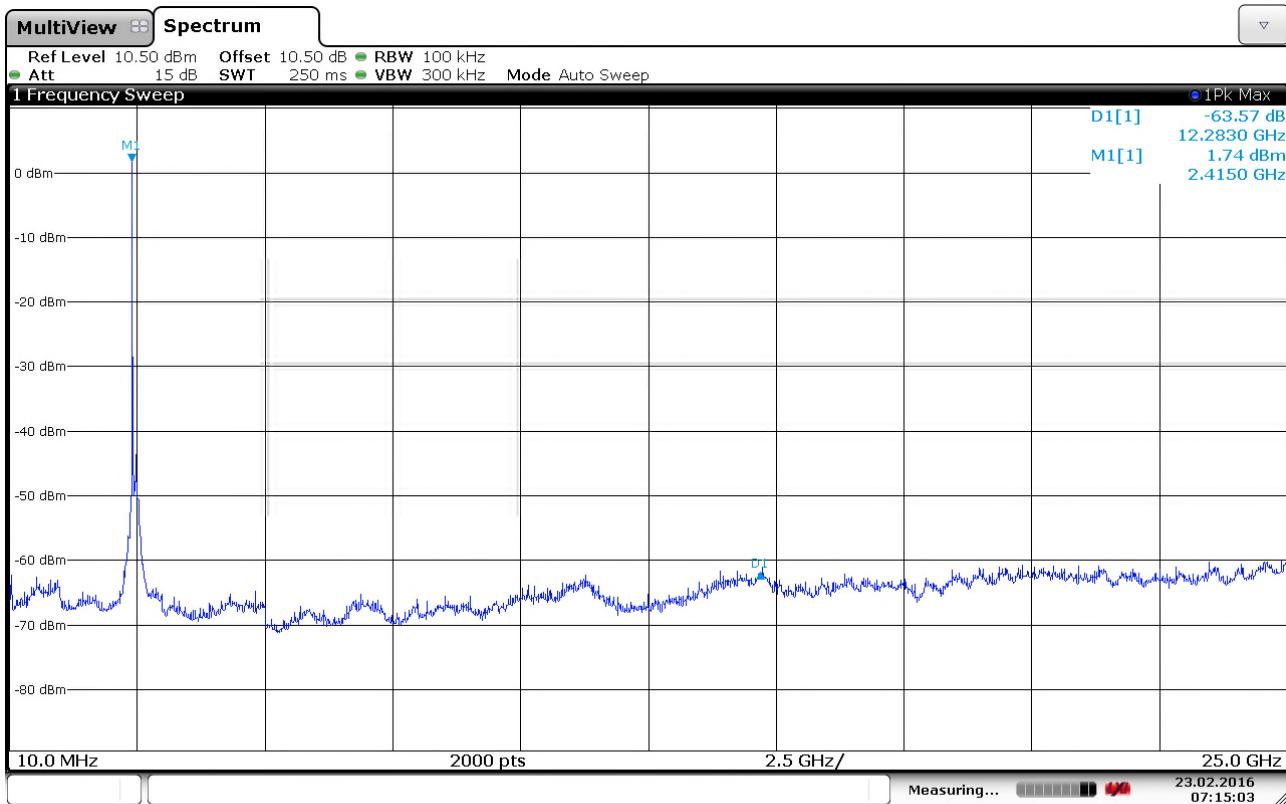
RF ch 2437 MHz:> 30 dB/C, margin >30 dB

RF ch 2462MHz: > 30dB/C, margin >30 dB



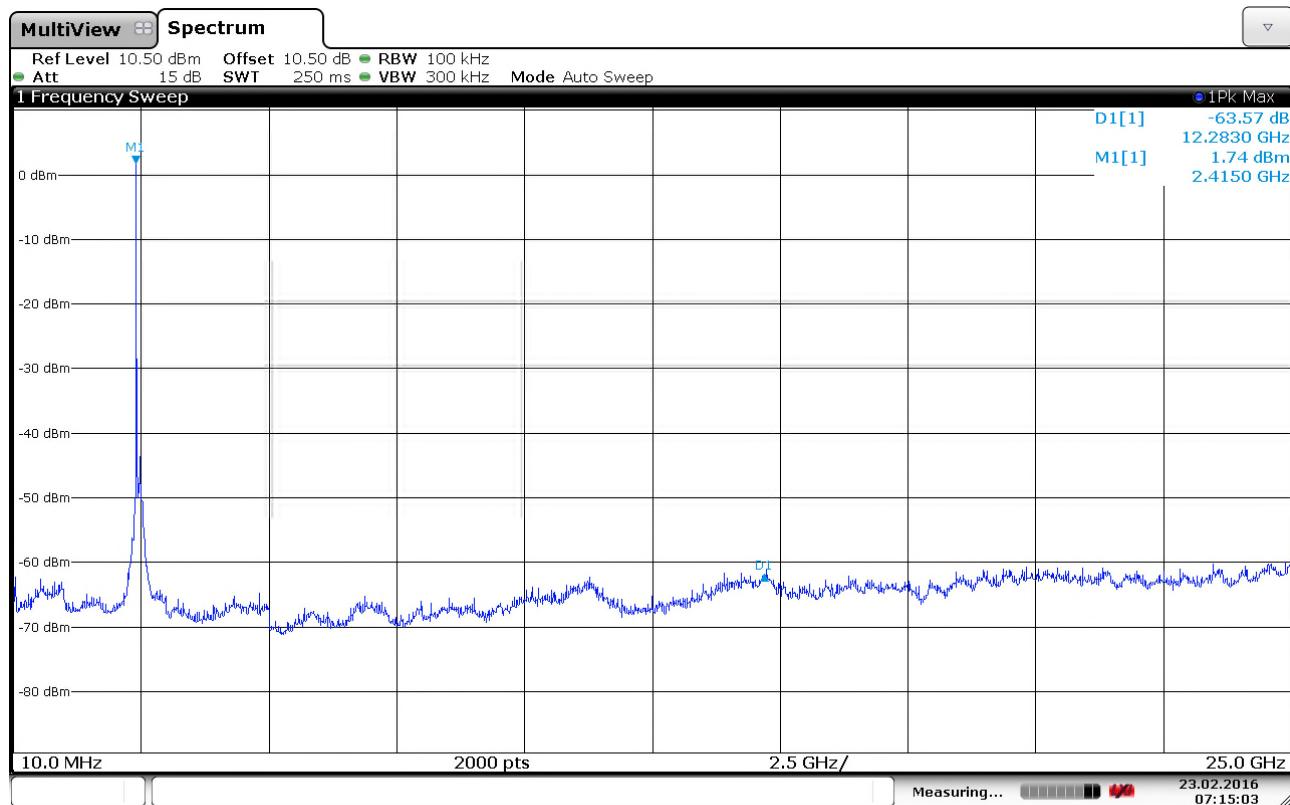
Date: 23.FEB.2016 07:19:29

Conducted Emissions 10 MHz – 25 GHz, 2412 MHz, 802.11b, 5.5Mbps



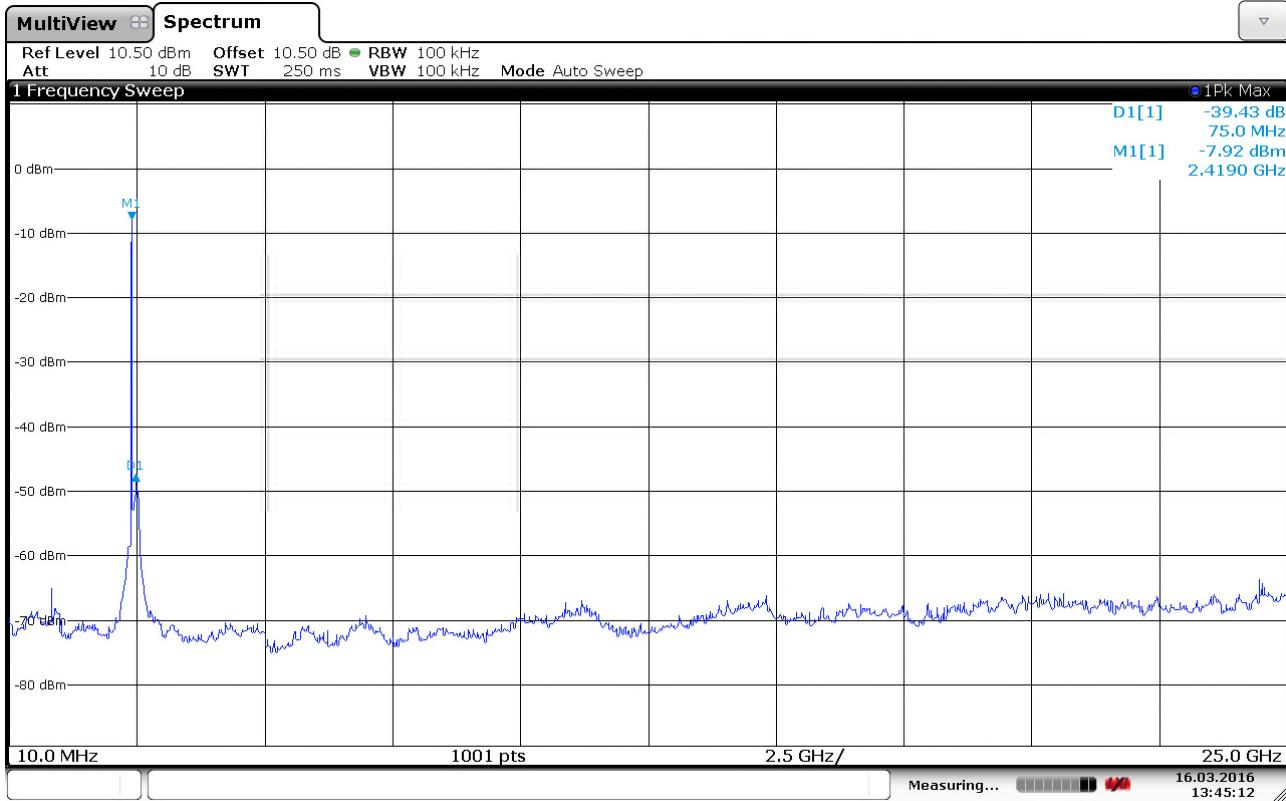
Date: 23.FEB.2016 07:15:03

Conducted Emissions 10 MHz – 25 GHz, 2437 MHz, 802.11b, 5.5Mbps

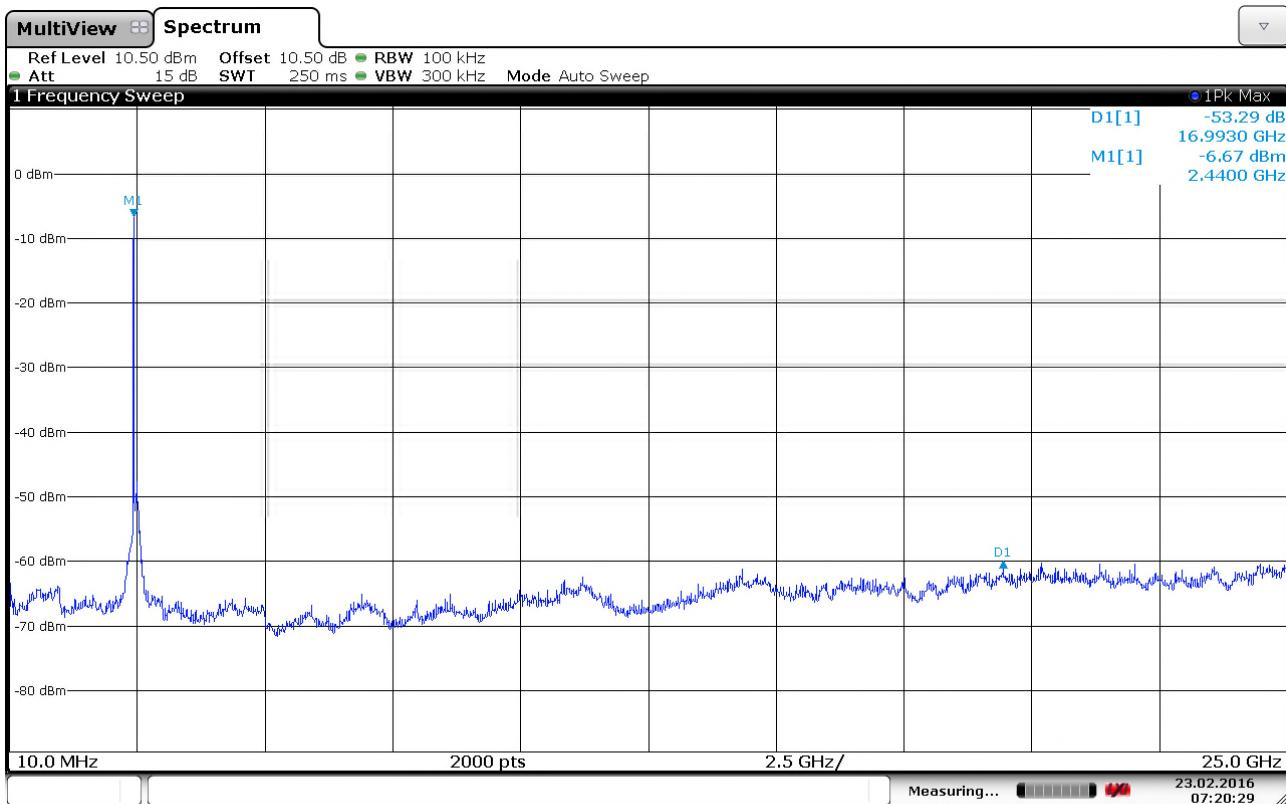


Date: 23.FEB.2016 07:15:03

Conducted Emissions 10 MHz – 25 GHz, 2462 MHz, 802.11b, 5.5Mbps

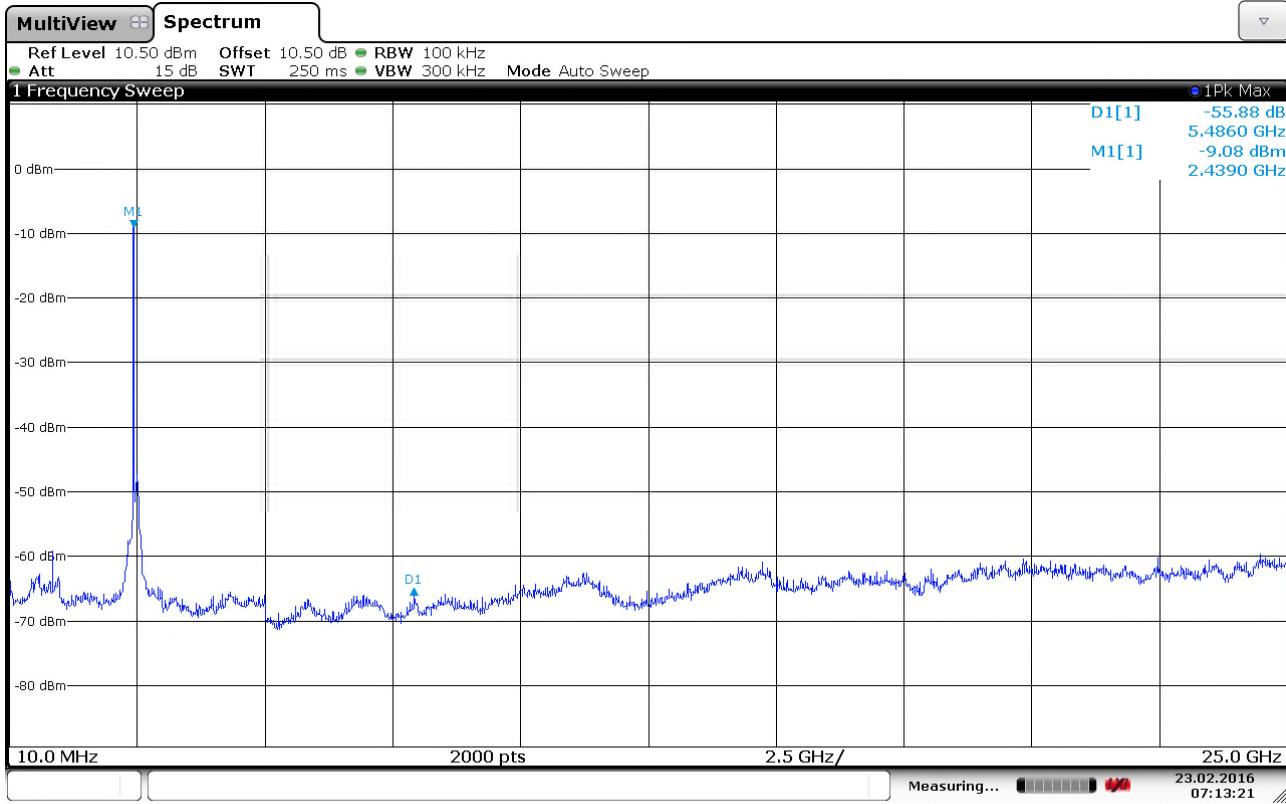


Conducted Emissions 10 MHz – 25 GHz, 2412 MHz, 802.11g, 9Mbps



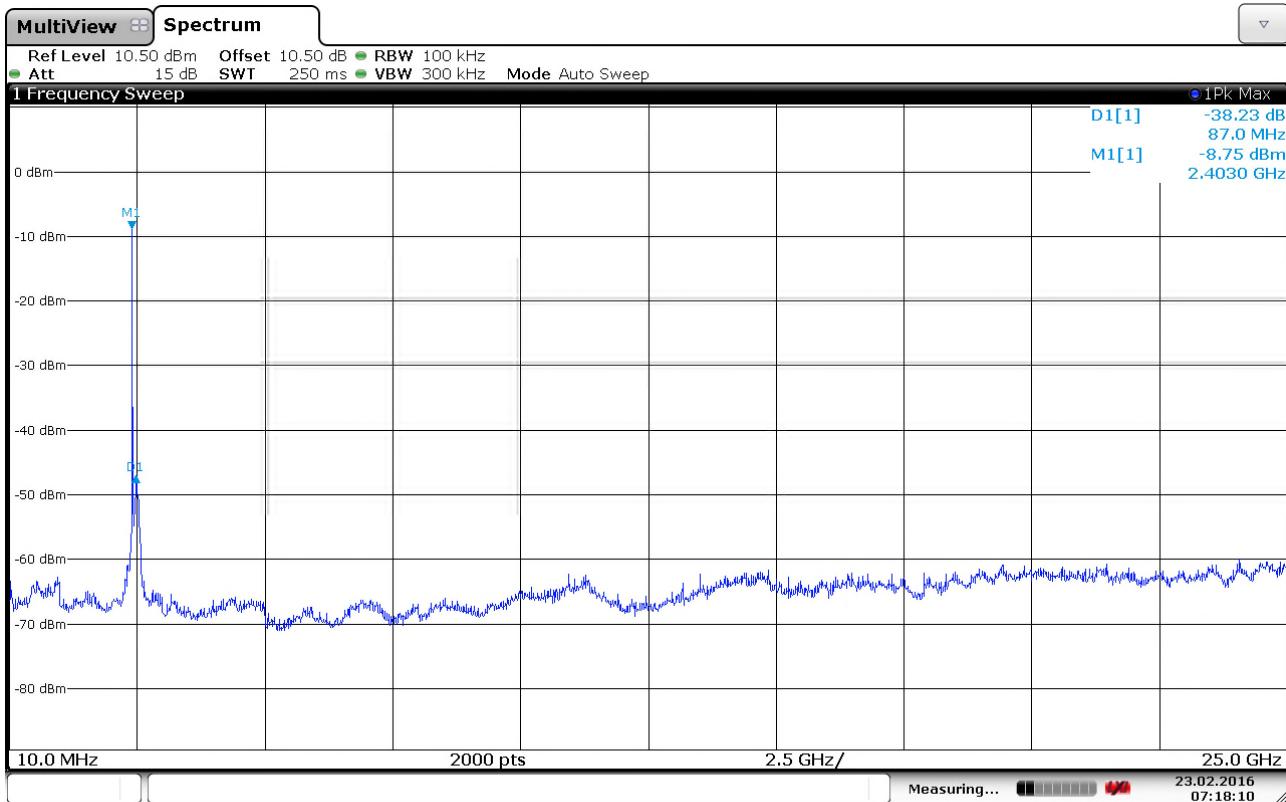
Date: 23.FEB.2016 07:20:29

Conducted Emissions 10 MHz – 25 GHz, 2437 MHz, 802.11g, 9Mbps



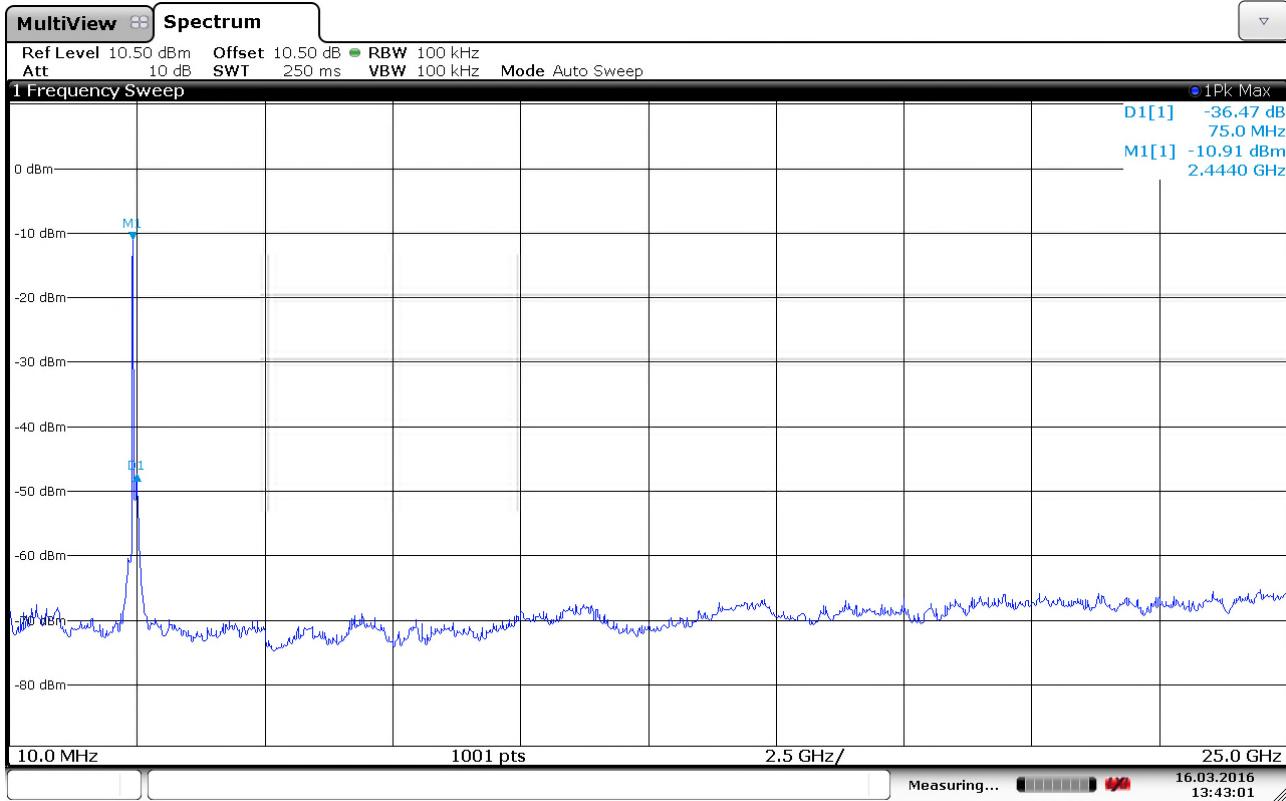
Date: 23.FEB.2016 07:13:21

Conducted Emissions 10 MHz – 25 GHz, 2462 MHz, 802.11g, 9Mbps

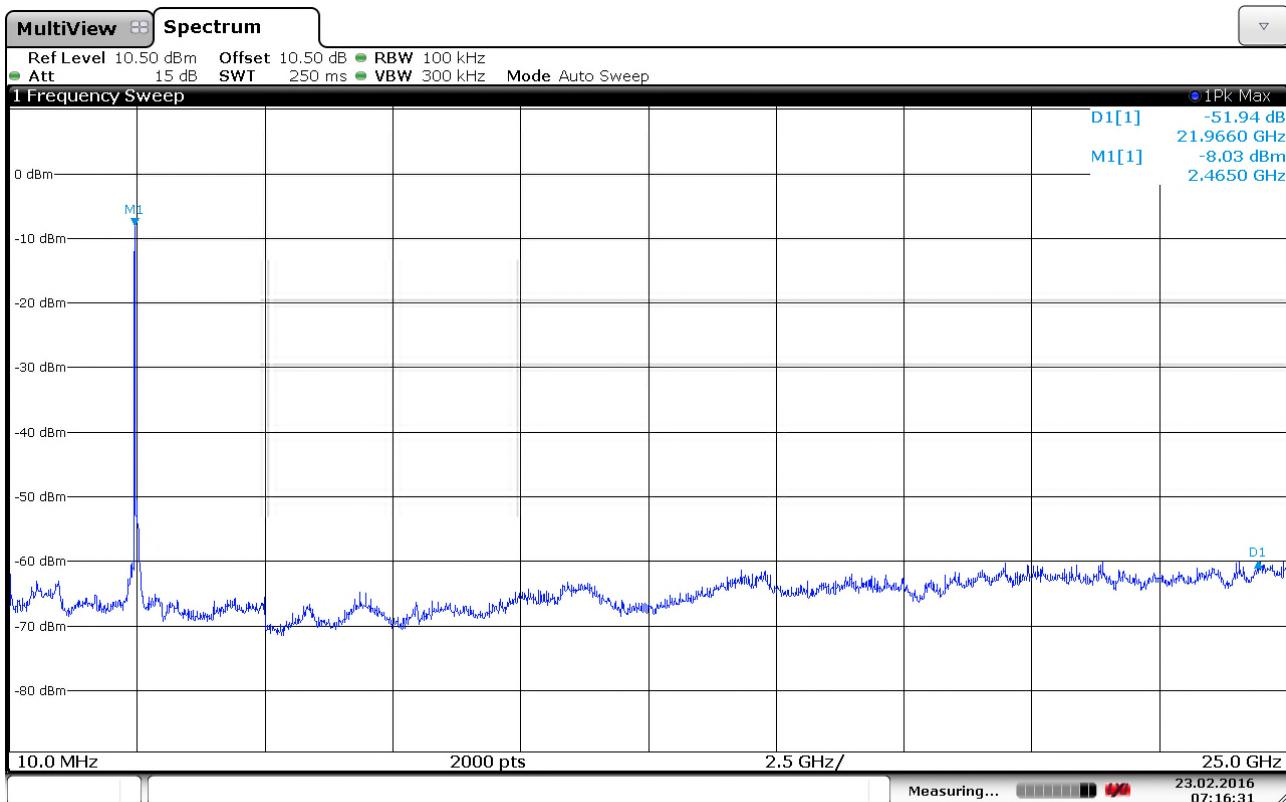


Date: 23.FEB.2016 07:18:10

Conducted Emissions 10 MHz – 25 GHz, 2412 MHz, 802.11n, 65Mbps



Conducted Emissions 10 MHz – 25 GHz, 2437 MHz, 802.11n, 65Mbps

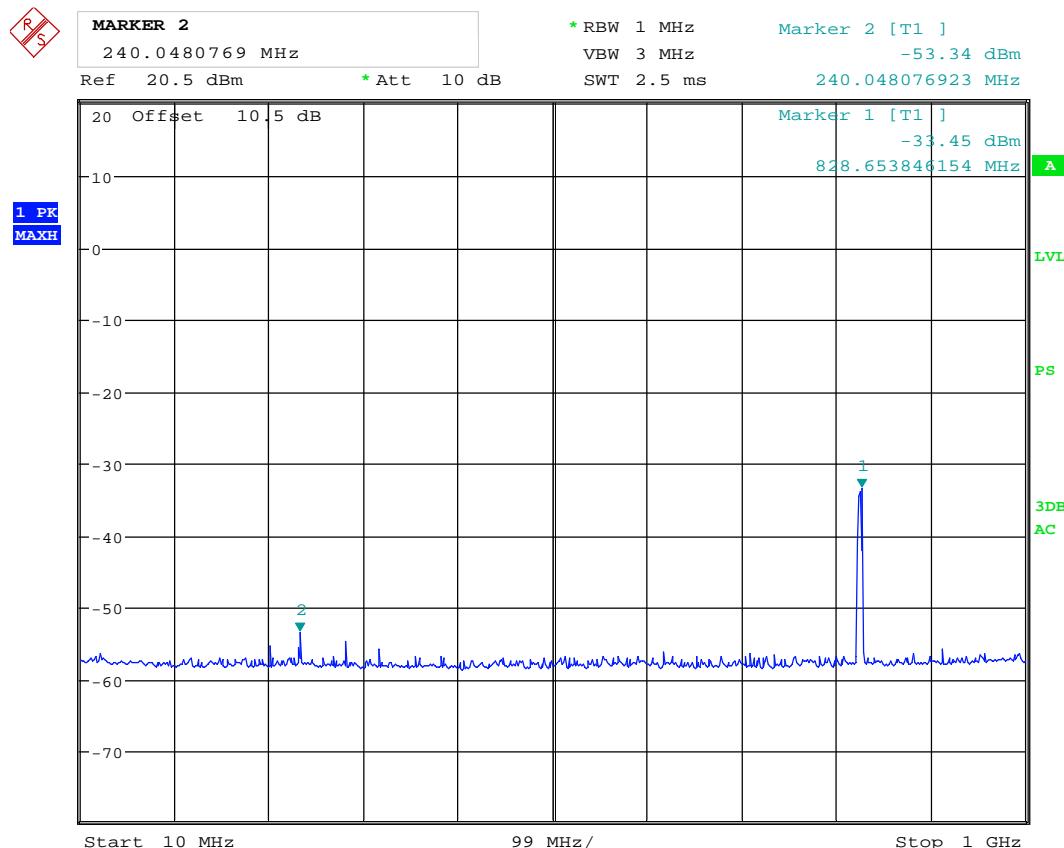


Date: 23.FEB.2016 07:16:30

Conducted Emissions 10 MHz – 25 GHz, 2462 MHz, 802.11n, 65Mbps

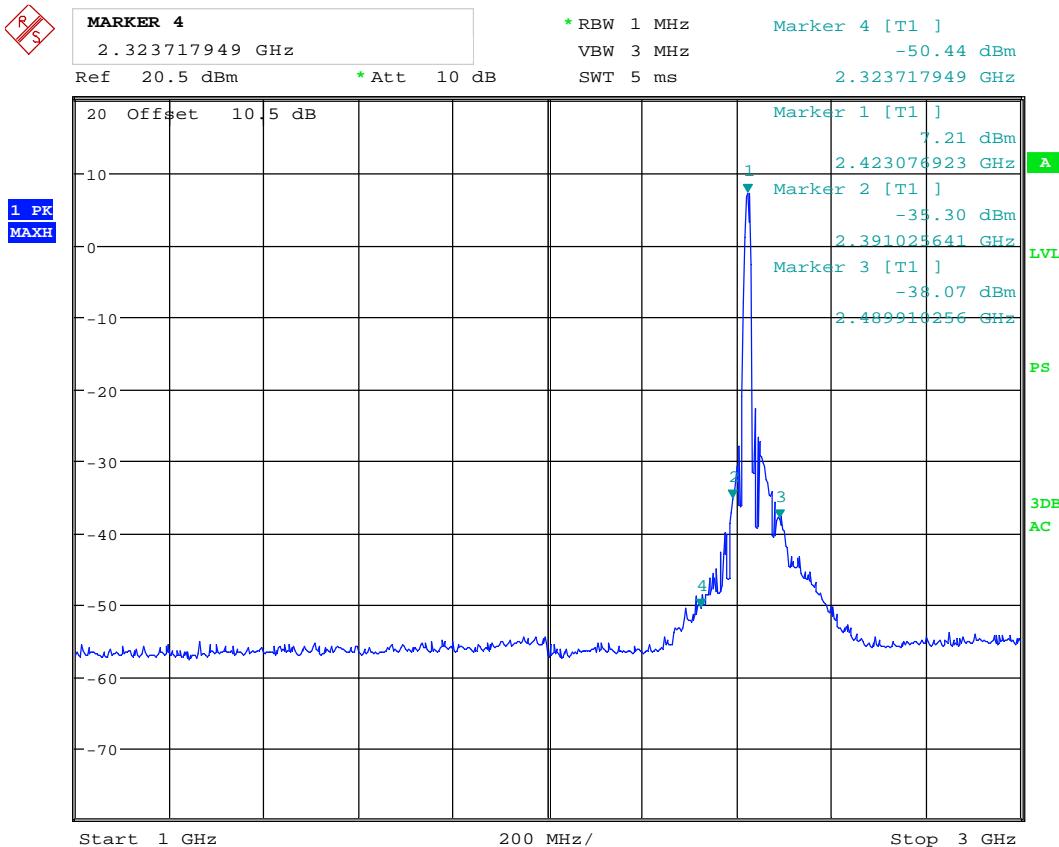
CONDUCTED EMISSIONS WITH ALL RADIO'S ON AND ACTIVE

All spurious in the restricted band is below 50 dB from the carrier.



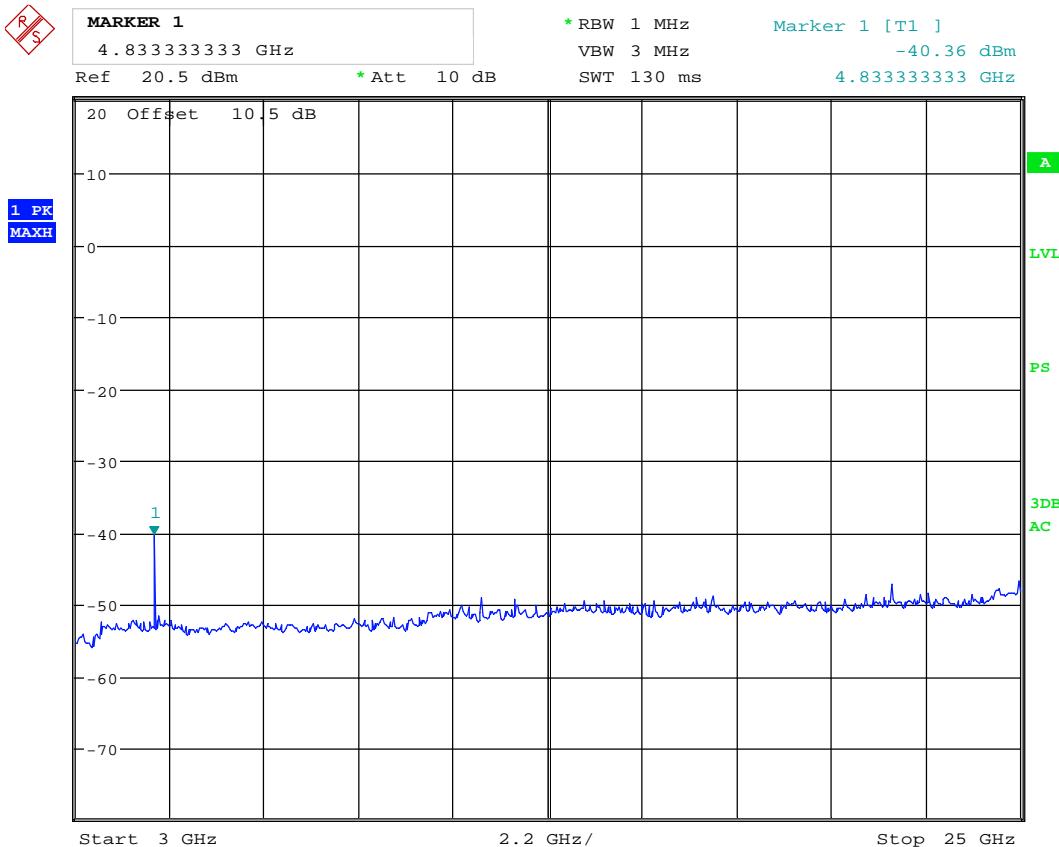
Date: 3.AUG.2016 19:05:40

Conducted Emissions 10 MHz – 1 GHz, on wi-fi RF port



Date: 3.AUG.2016 19:04:45

Conducted Emissions 1 - 3 GHz, on wi-fi RF port



Date: 3.AUG.2016 19:06:57

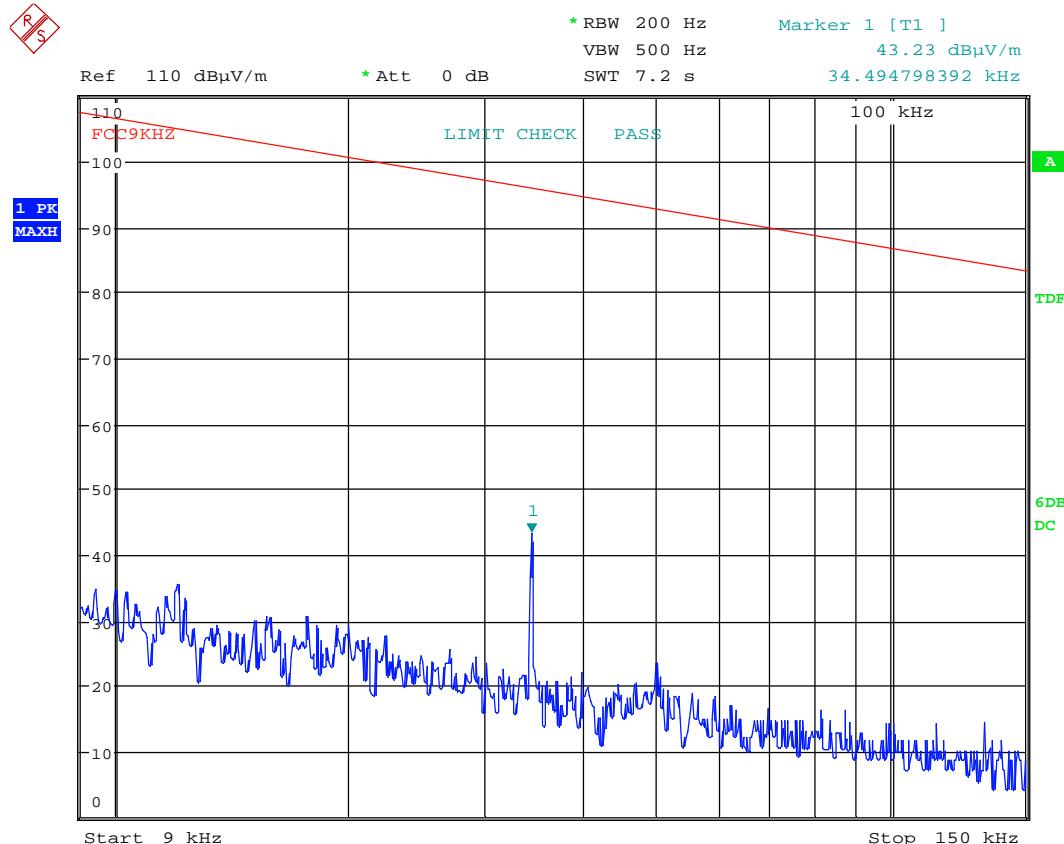
Conducted Emissions 3 - 25GHz, on wi-fi RF port

Radiated emissions 9 kHz-30 MHz.

Measuring distance 10 m, measured with Peak detector.

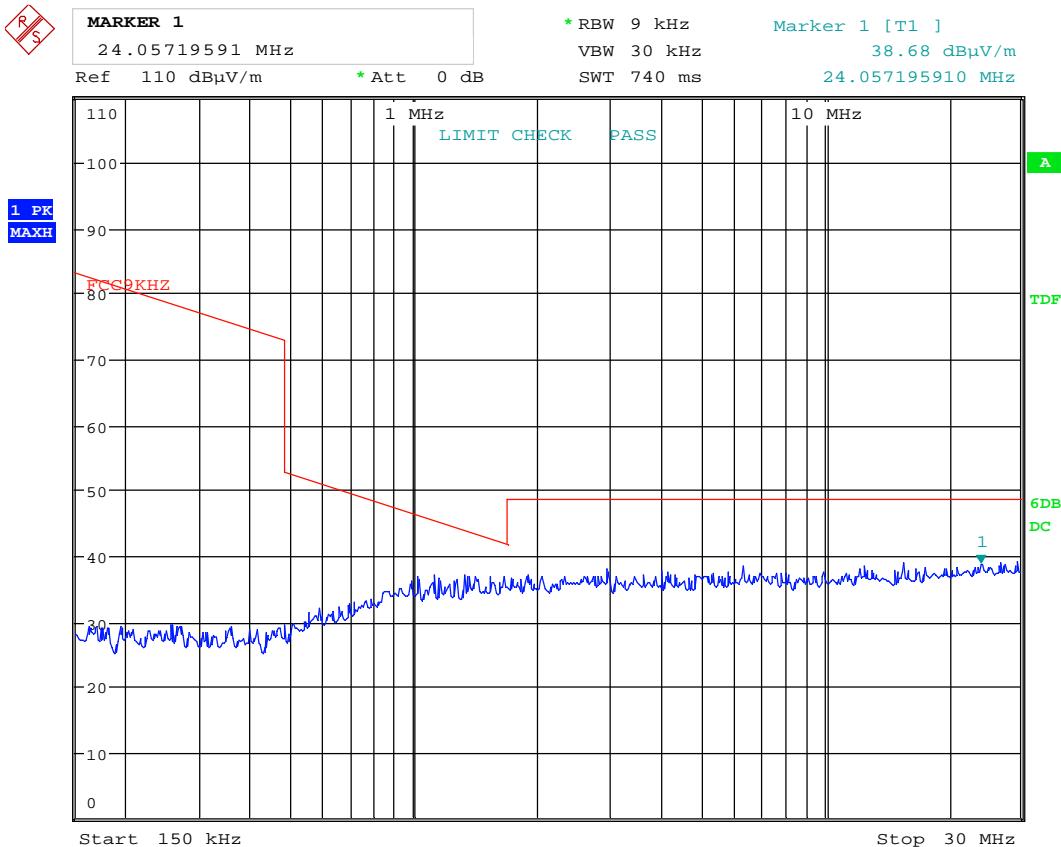
No component detected, see attached graph.

Limit is converted to 10 m using 40 dB/decade according to 15.31 (f) (2).



Date: 10.MAR.2016 08:30:29

9kHz – 150kHz



Date: 10.MAR.2016 08:31:52

150KHz – 30MHz



Radiated emission 30 – 1000 MHz.

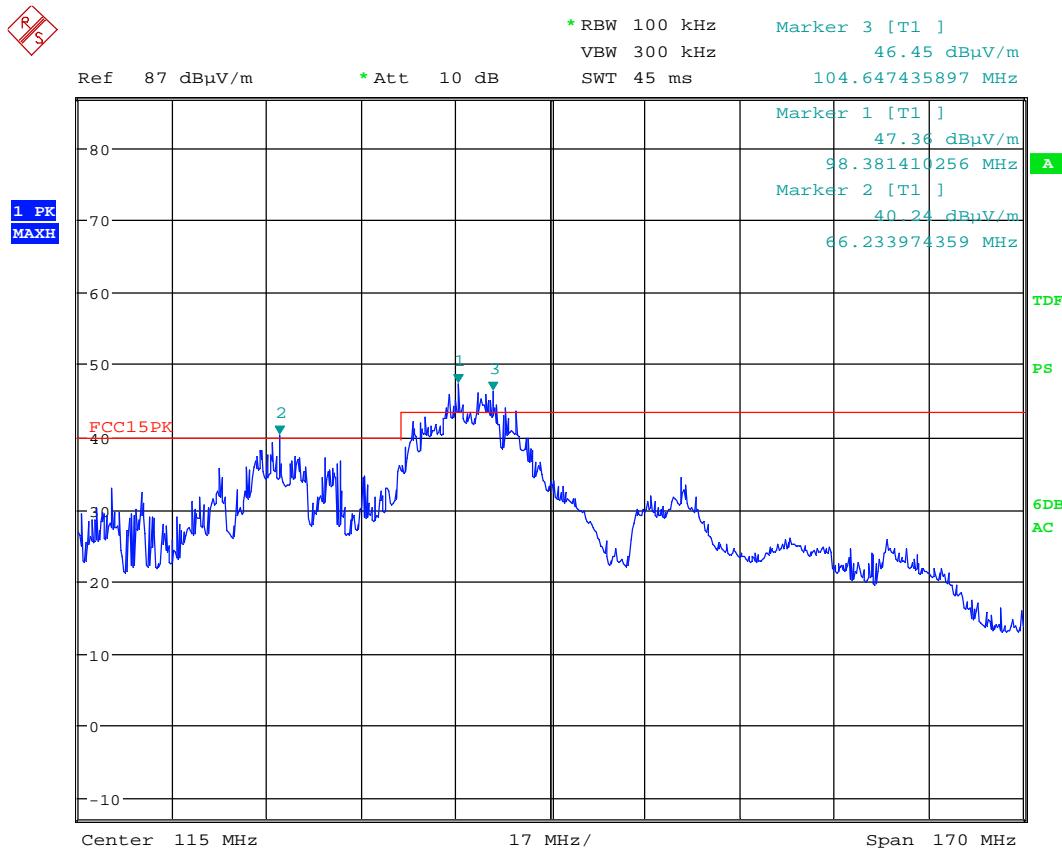
Detector: Quasi-Peak

Measuring distance 3m.

Frequency	Operational condition	Detector	Field strength	Measuring distance	Limit FCC15.209	Margin
MHz			dB μ V/m	metres	dB μ V/m	dB
66.23	TX on	QP	39.83	3	40.0	0.17
98.38	TX on	QP	42.36	3	43.5	1.17
104.67	TX on	QP	38.38	3	43.5	5.12

The maximum is obtained at Vertical polarization

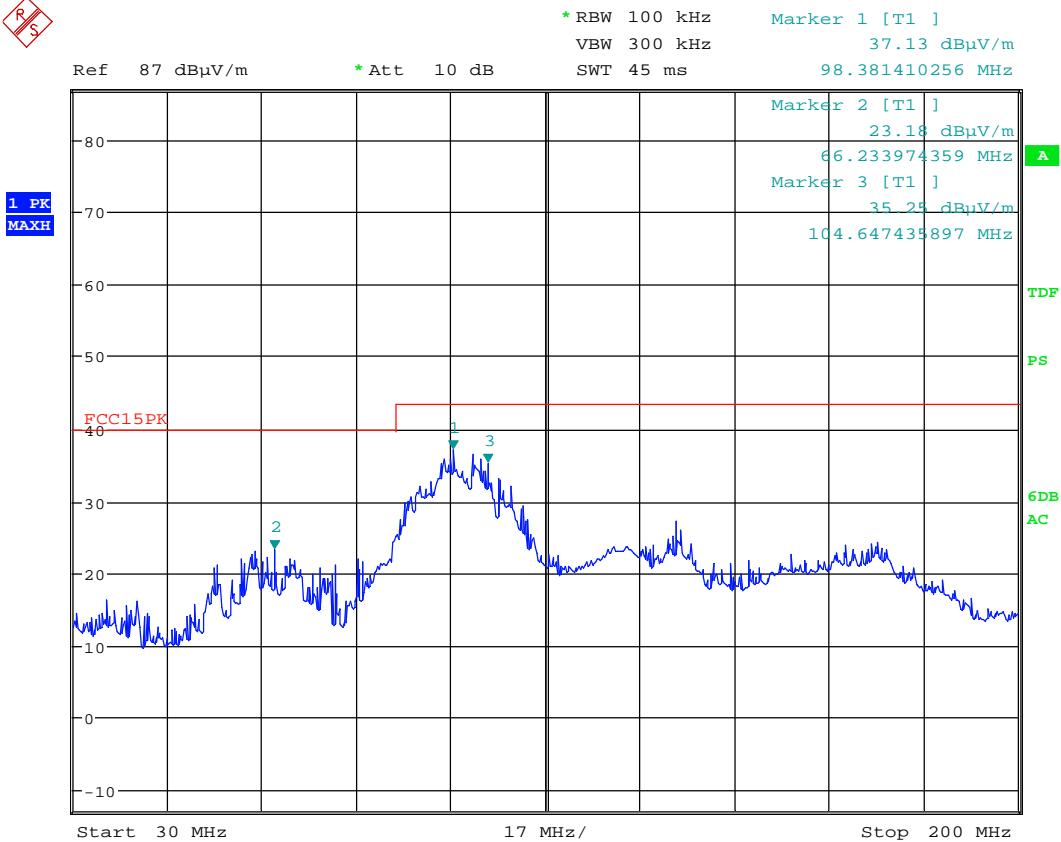
See attached graphs.



Date: 10.MAR.2016 07:15:23

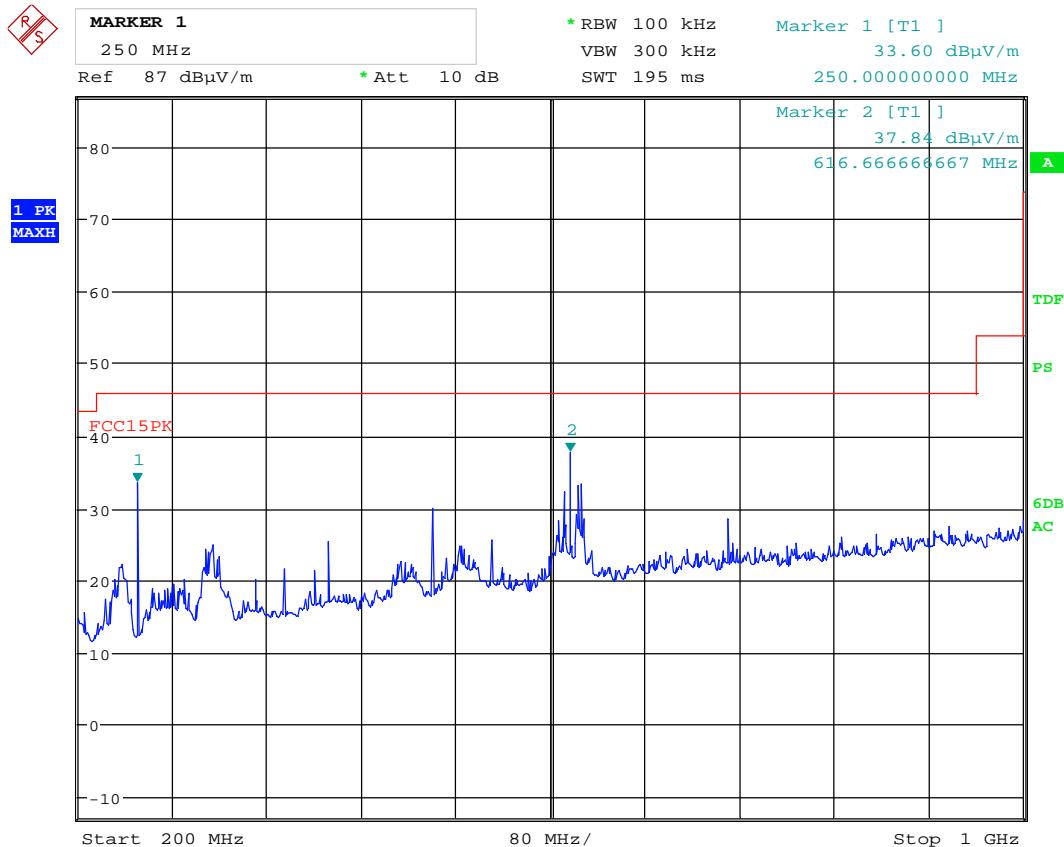
Radiated Emissions, 30 – 200 MHz, VP , @3m, PK scan

R
S



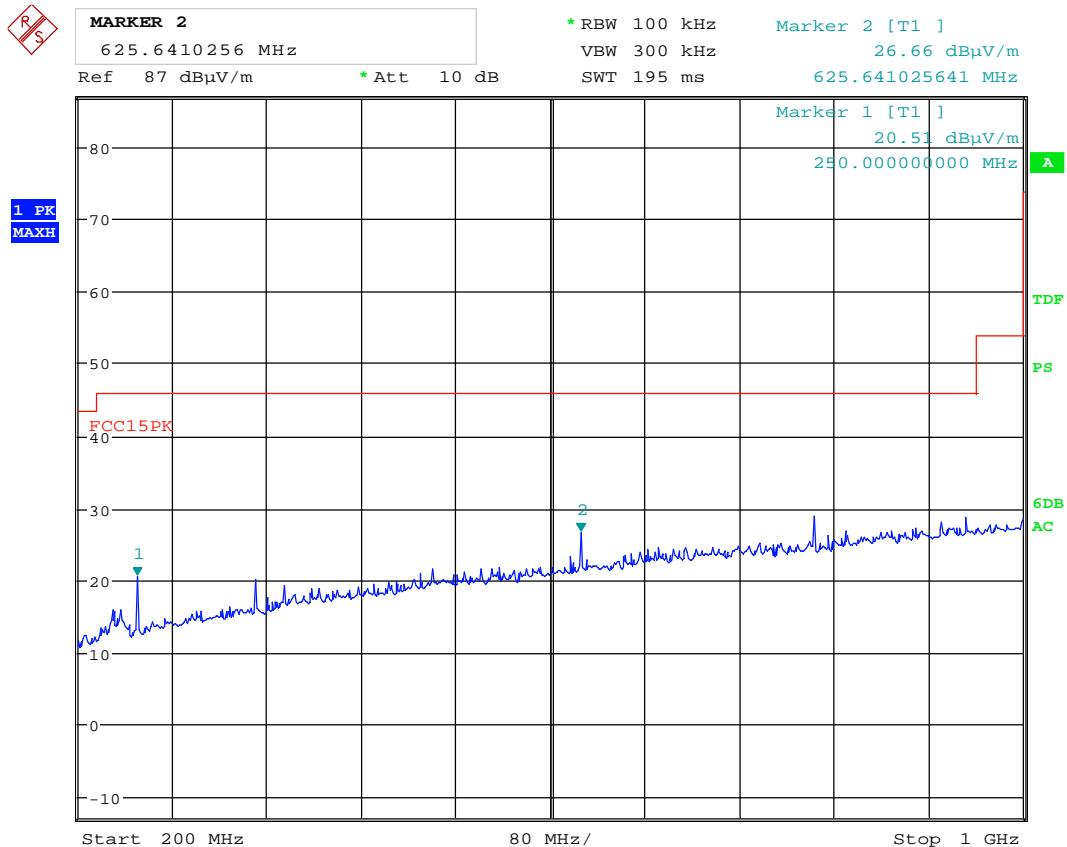
Date: 10.MAR.2016 07:17:38

Radiated Emissions, 30 – 200 MHz, HP , @3m, PK scan



Date: 10.MAR.2016 07:28:29

Radiated Emissions, 200 - 1000 MHz, VP , @3m, PK scan



Date: 10.MAR.2016 07:39:09

Radiated Emissions, 200 - 1000MHz, HP , @3m, PK scan

Radiated Emissions, 1-25 GHz

Measuring distance: 3m (1 – 8.5 GHz)
 1m (8.5 – 18 GHz)

A pre-scan was performed above 18 GHz and no spurious emissions were detected.

Peak Detector:

Frequency	RF channel	Modulation type	Dist. corr. factor	Field strength, Peak Detector	Duty cycle corr. factor	Limit	Margin
GHz	L,M,H	Mbps	dB	dB μ V/m	dB	dB μ V/m	dB
4.824	L	5.5	0	55.90	0	74	18.1
4.874	M	5.5	0	53.71	0	74	20.3
4.924	H	5.5	0	53.48	0	74	20.5
9.648	L	9	0	40.82	0	74	33.2
-	M	9	*	None detected	0	74	-
9.848	H	9	*	40.57	0	74	33.4
9.648	L	65	*	41.74	0	74	32.3
-	M	65	*	None detected	0	74	-
9.848	H	65	*	41.43	0	74	32.6
Other freqs	L,M,H	all	0	None detected	0	74	-

*Distance correction of -9.5 dB for 1m is included in the plots

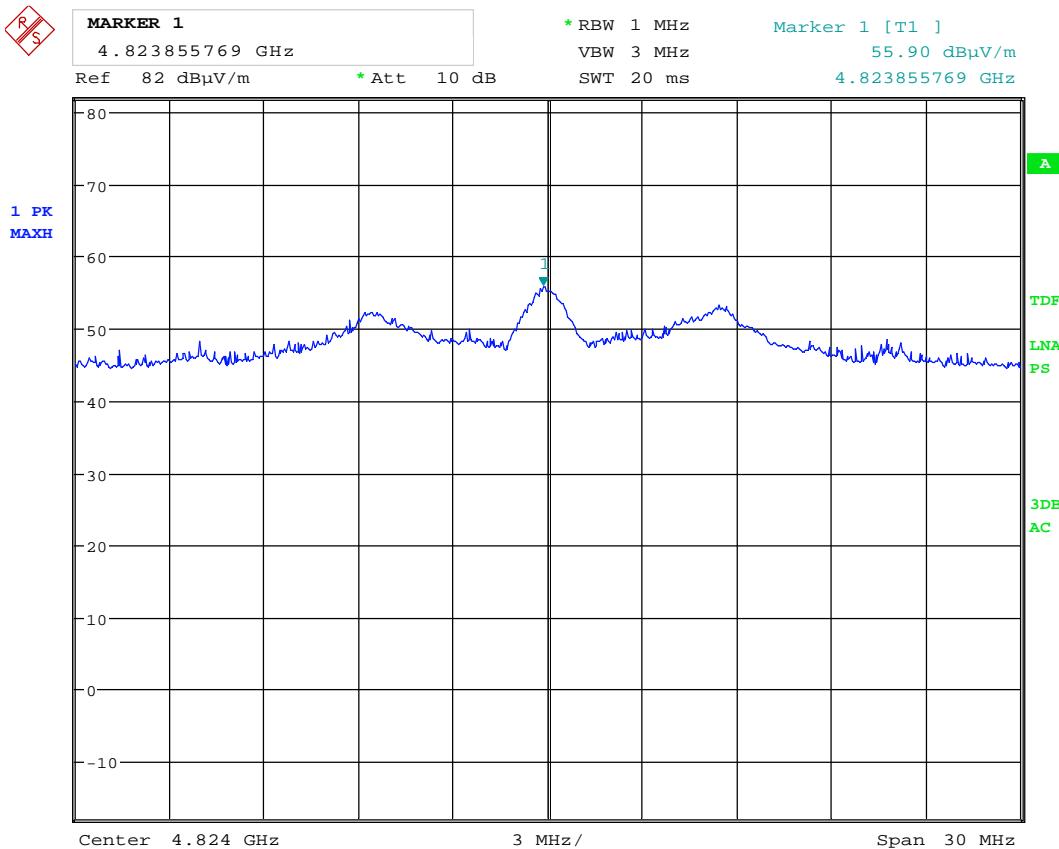
Average Detector:

Frequency	RF channel	Modulation type	Dist. corr. factor	Field strength, Average Detector	Duty cycle corr. factor	Limit	Margin
GHz	L,M,H	Mbps	dB	dB μ V/m	dB	dB μ V/m	dB
4.824	L	5.5	0	53.94	0	54	0.06
4.874	M	5.5	0	51.75	0	54	2.25
4.924	H	5.5	0	51.63	0	54	2.37
9.648	L	9	0	35.85	0	54	18.15
-	M	9	*	None detected	0	54	-
9.848	H	9	*	36.27	0	54	17.73
9.648	L	65	*	48.70	0	54	5.30
-	M	65	*	None detected	0	54	-
9.848	H	65	*	48.98	0	54	5.02
Other freqs	L,M,H	all	0	None detected	0	54	-

* Distance correction of -9.5 dB for 1m and duty cycle correction is included in the plots

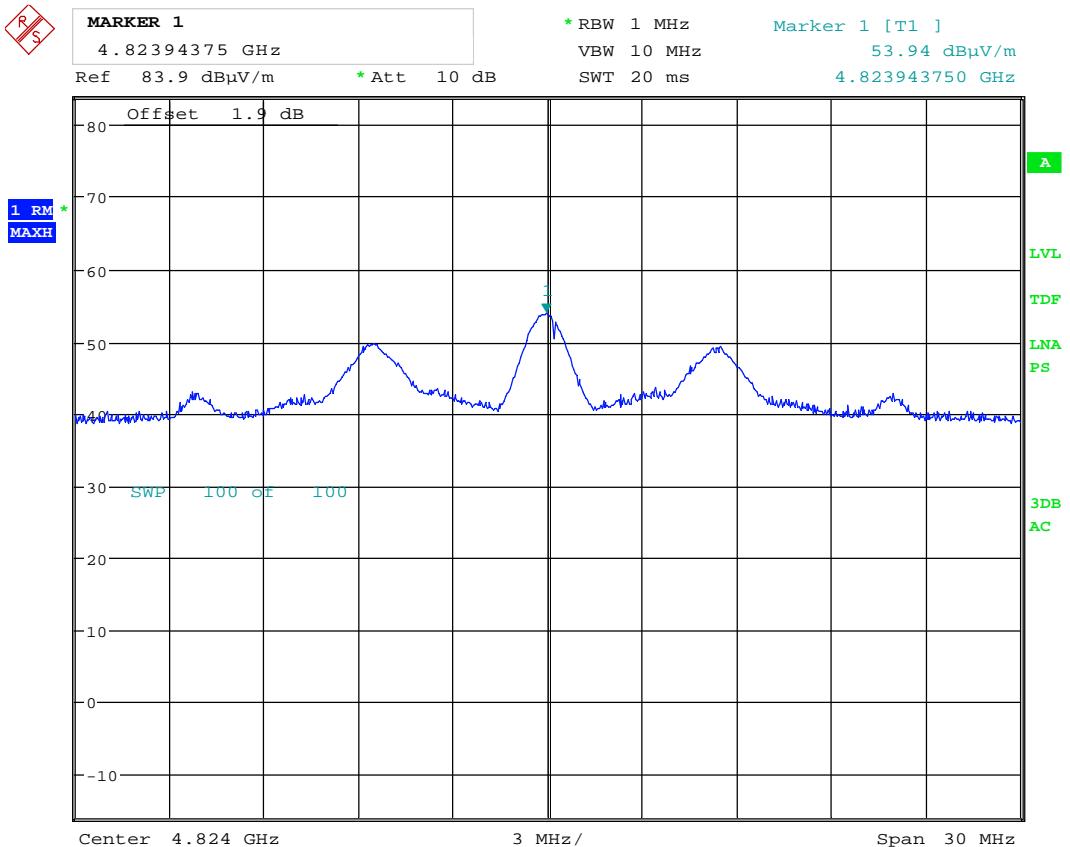
Antenna factor, amplifier gain and cable loss are included in spectrum analyzer "Transducer factor".

See plots.



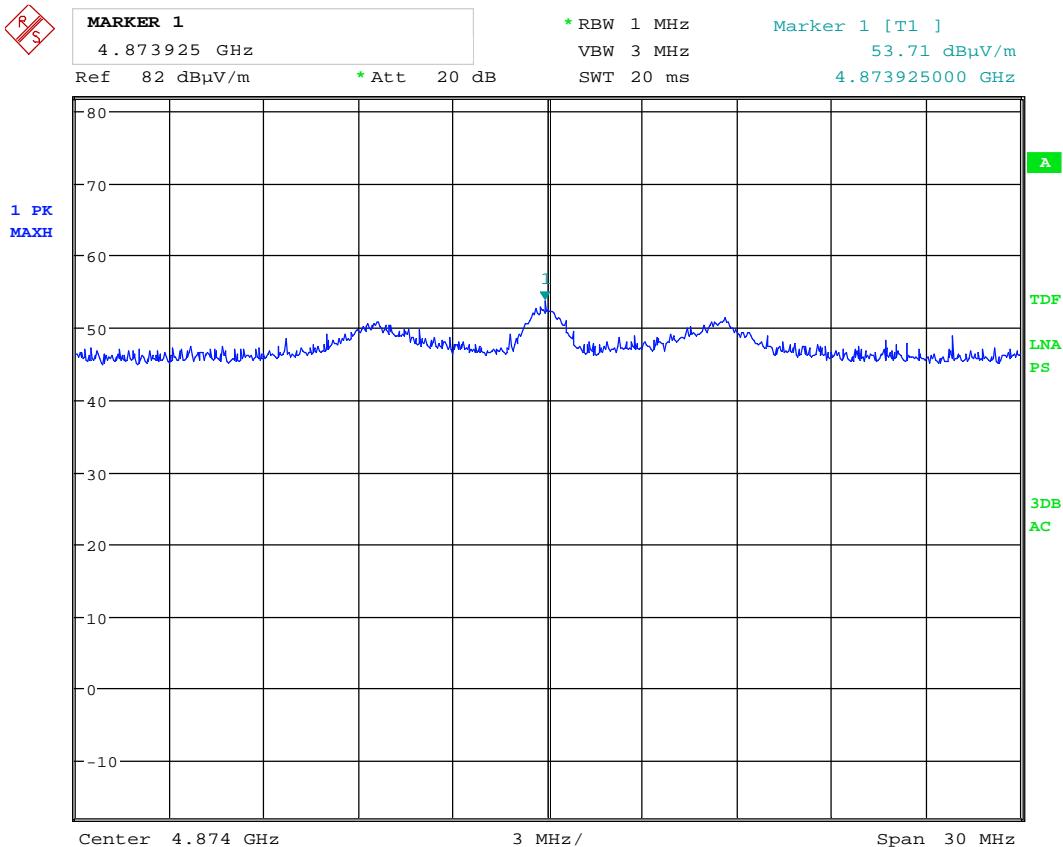
Date: 18.FEB.2016 13:39:20

2nd har , PK detector, 2412MHz, HP, 802.11b, 5.5Mbps



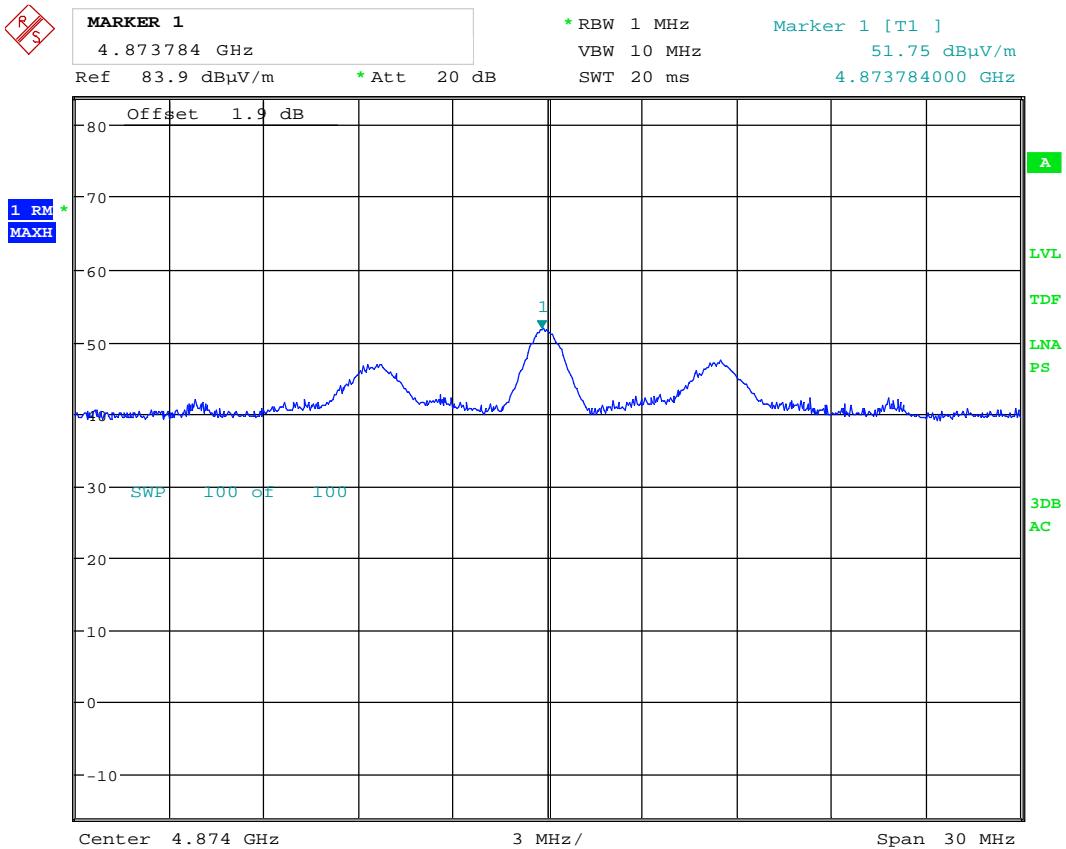
Date: 18.FEB.2016 13:48:30

2nd har , RMS detector, 2412MHz, HP, 802.11b, 5.5Mbps



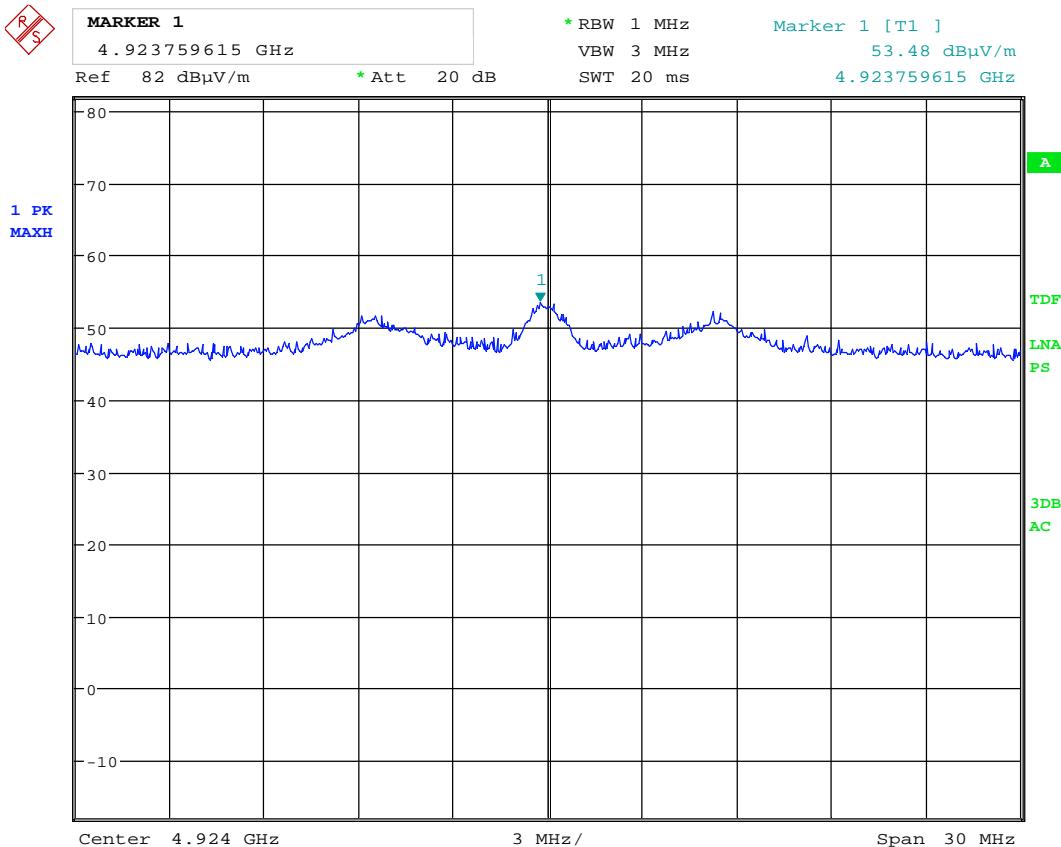
Date: 19.FEB.2016 07:56:26

2nd har , PK detector, 2437MHz, HP, 802.11b, 5.5Mbps



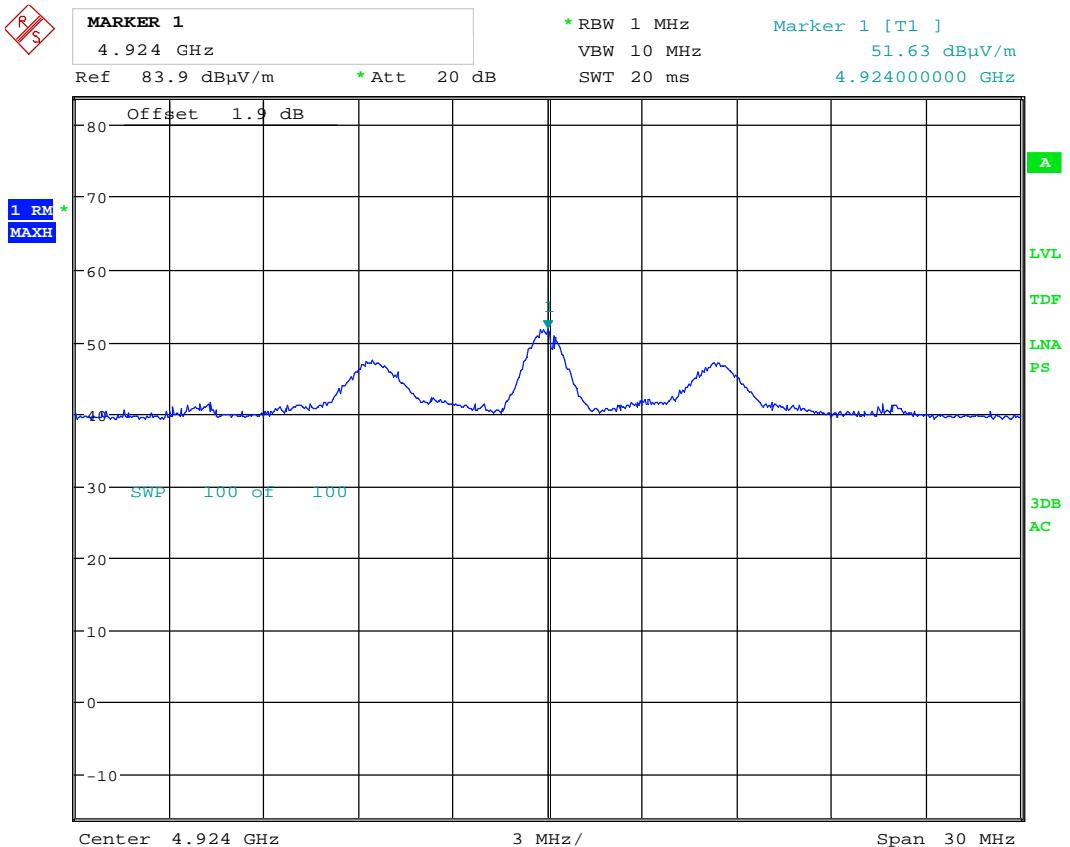
Date: 19.FEB.2016 07:57:23

2nd har , RMS detector, 2437MHz, HP, 802.11b, 5.5Mbps



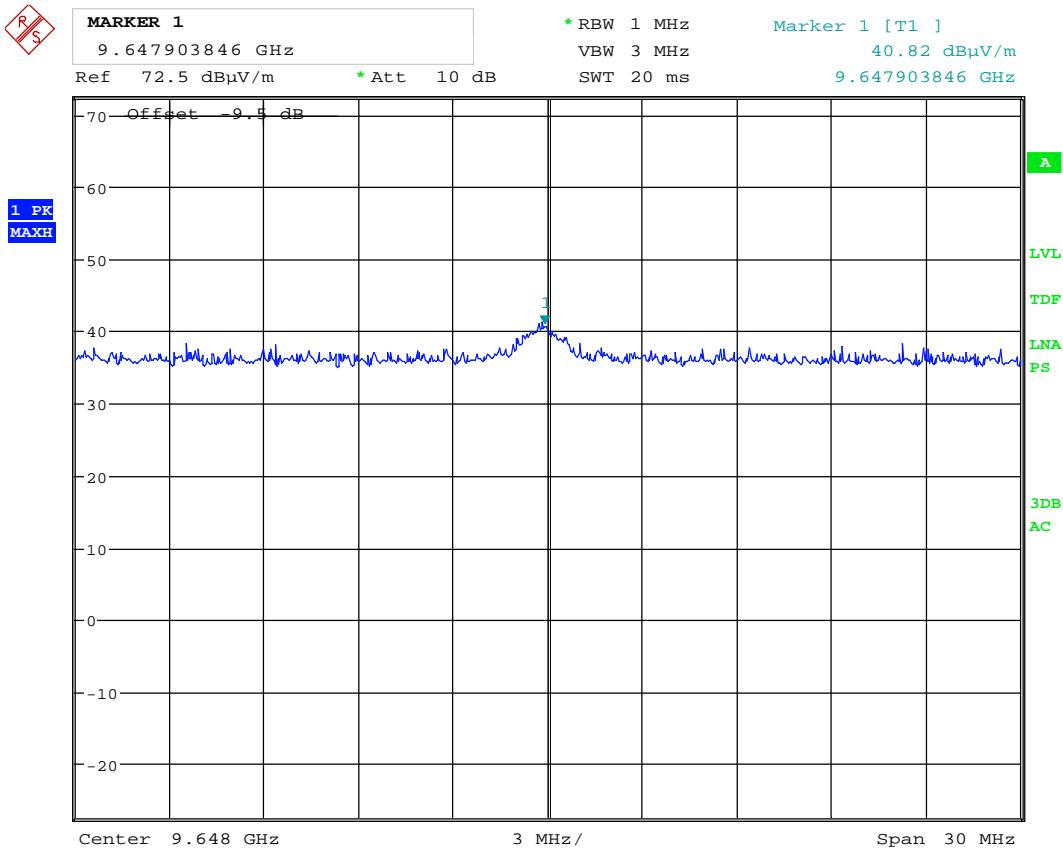
Date: 19.FEB.2016 07:10:59

2nd har , PK detector, 2462MHz, HP, 802.11b, 5.5Mbps



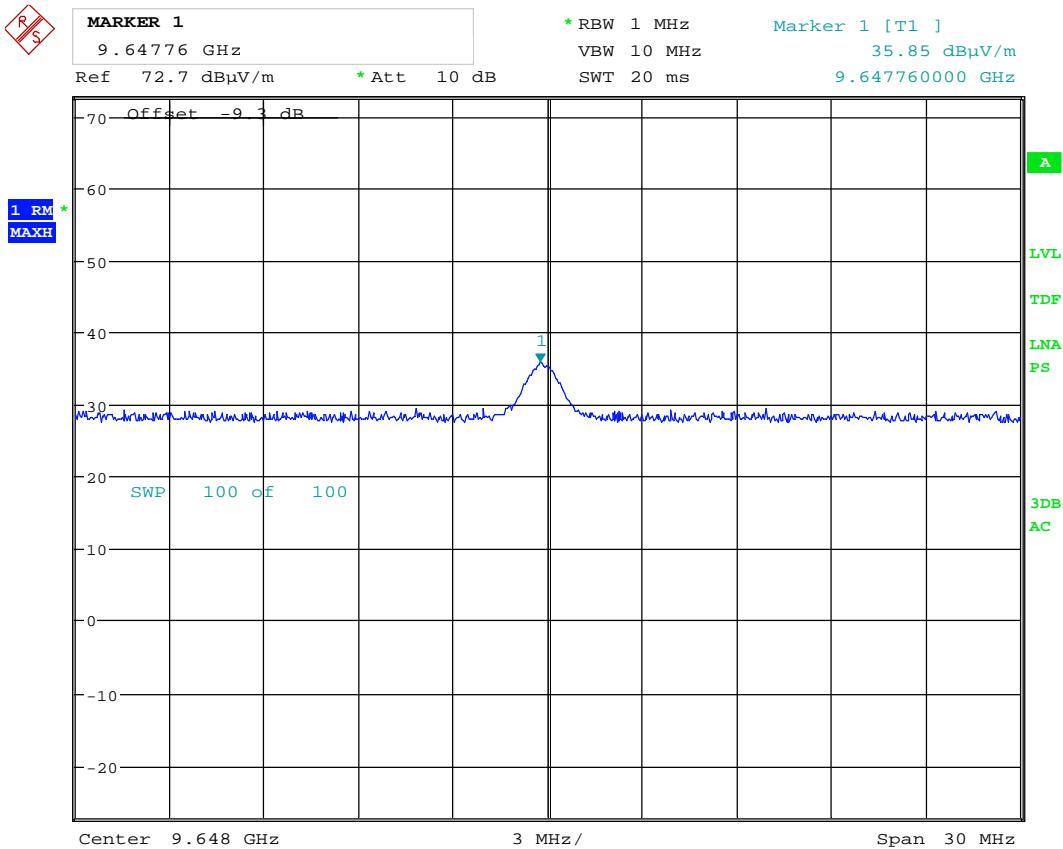
Date: 19.FEB.2016 07:12:53

2nd har , RMS detector, 2462MHz, HP, 802.11b, 5.5Mbps



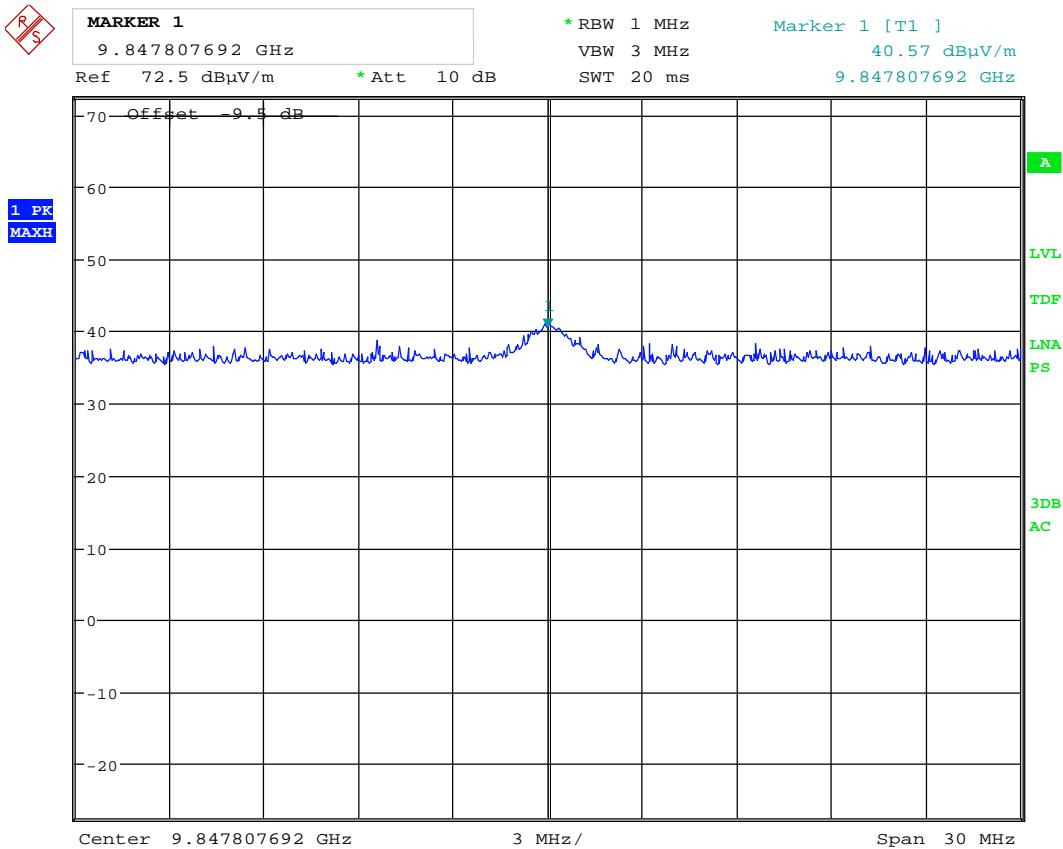
Date: 3.MAR.2016 13:56:20

4th har , PK detector, 2412MHz, VP, 802.11g, 9Mbps @1m



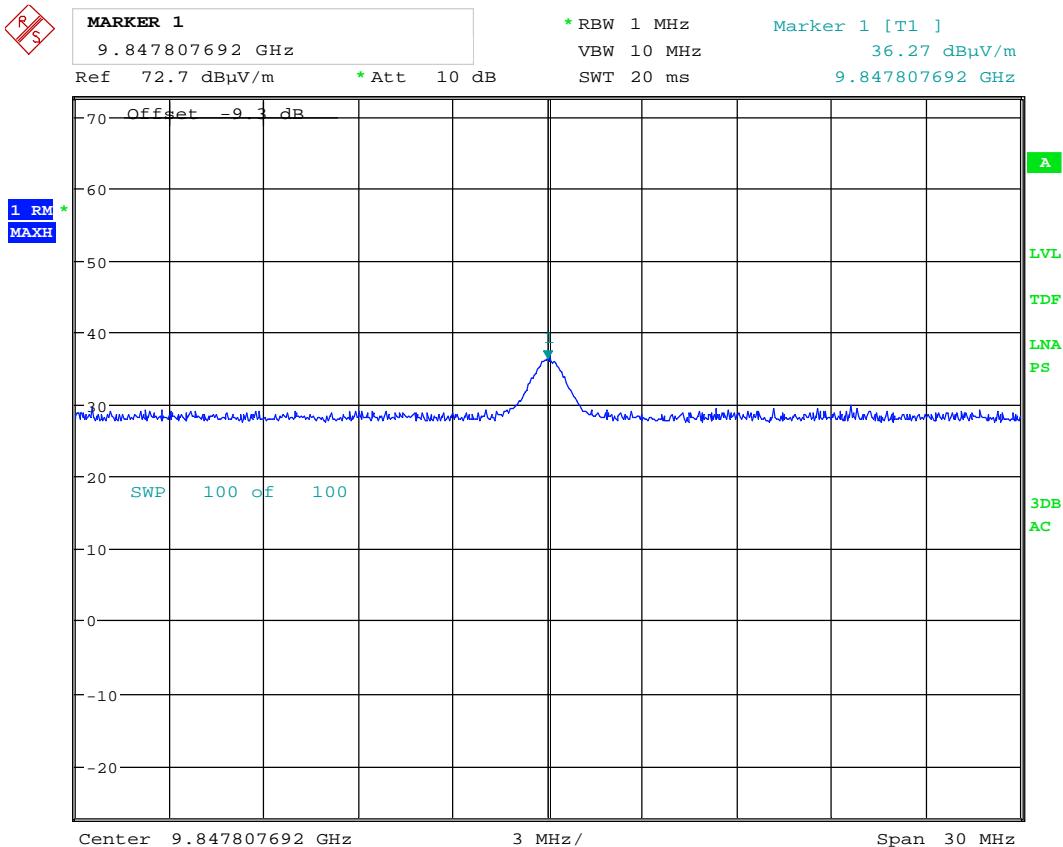
Date: 3.MAR.2016 13:55:32

4th har , RMS detector, 2412MHz, VP, 802.11g, 9Mbps @1m



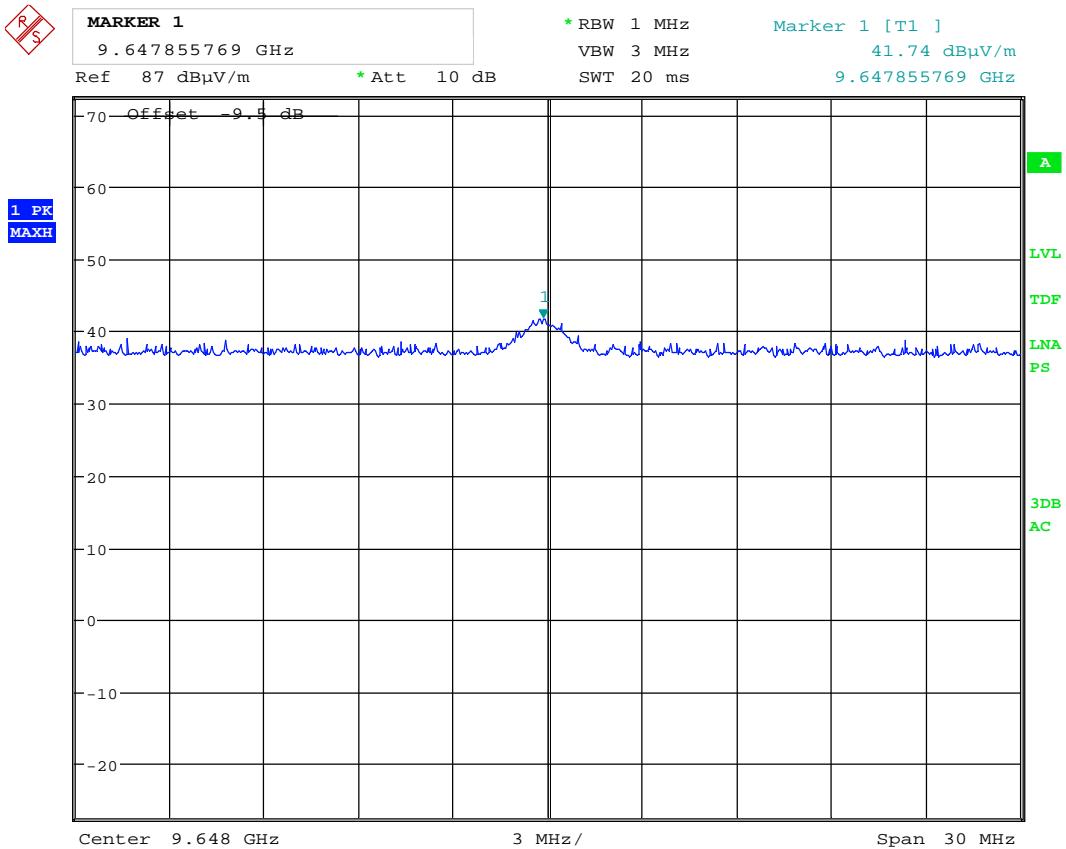
Date: 3.MAR.2016 13:52:43

4th har , PK detector, 2462MHz, VP, 802.11g, 9Mbps @1m



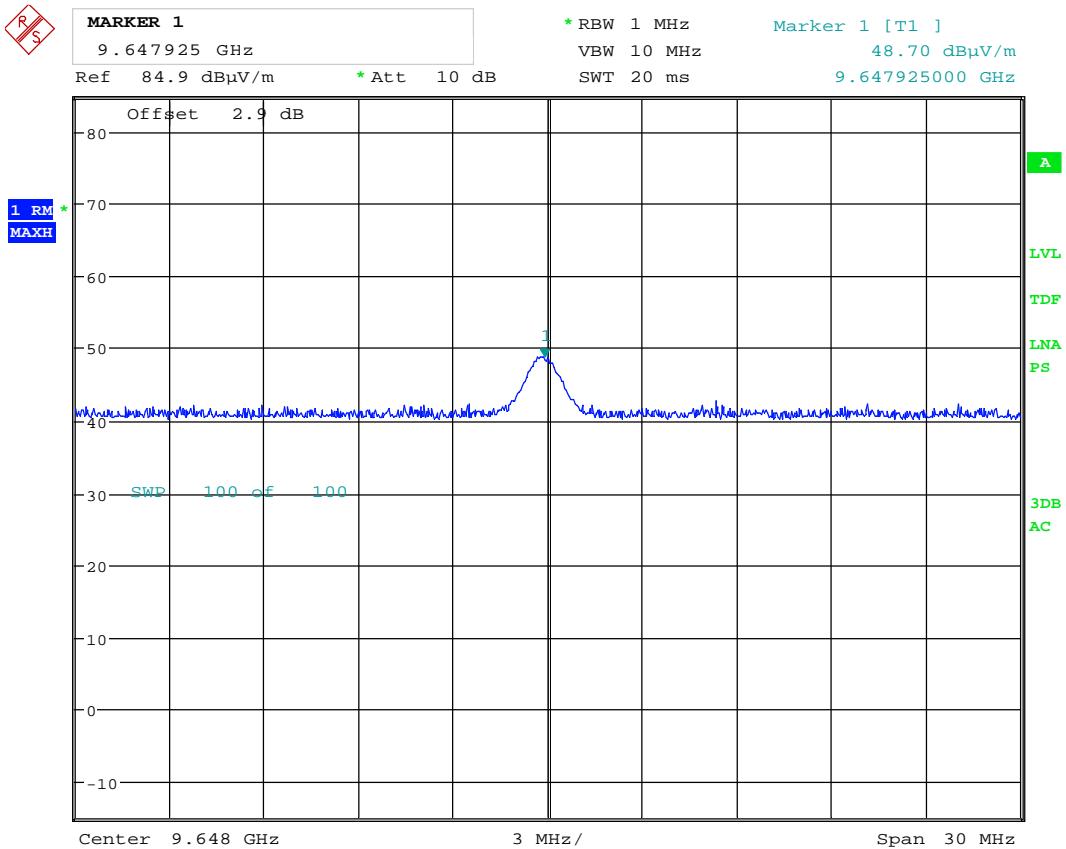
Date: 3.MAR.2016 13:53:53

4th har , RMS detector, 2462MHz, VP, 802.11g, 9Mbps @1m



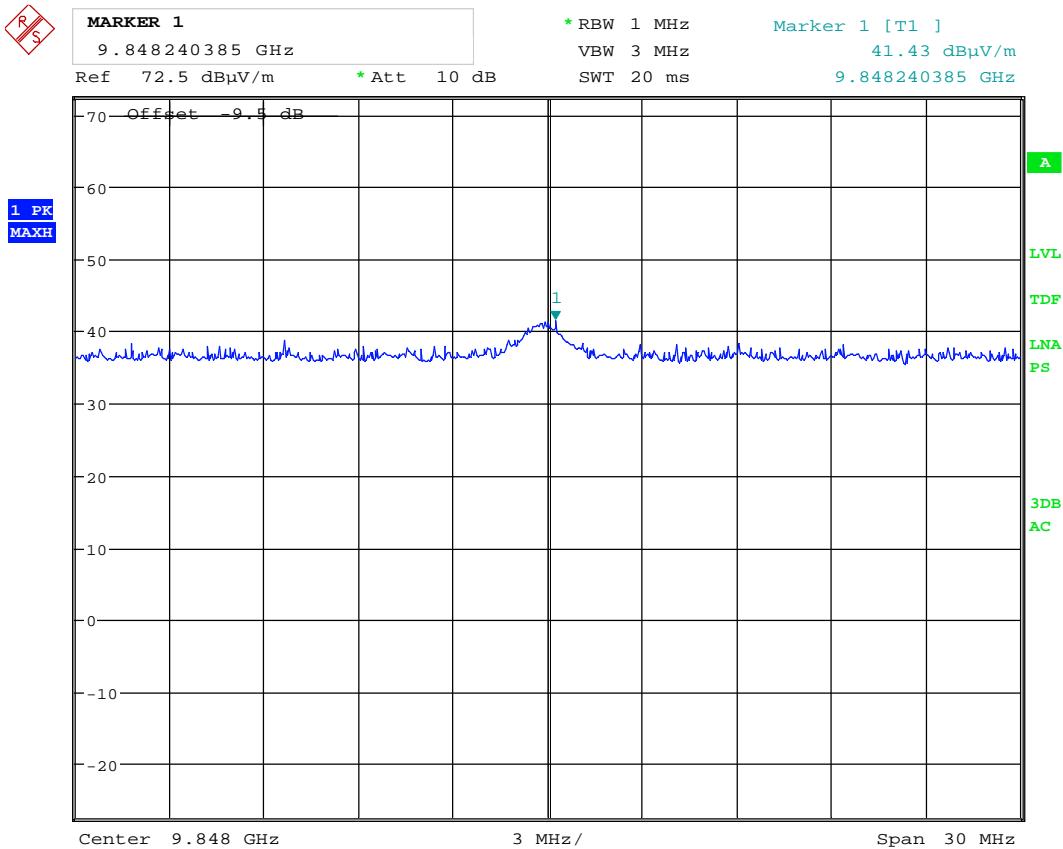
Date: 3.MAR.2016 13:44:14

4th har , PK detector, 2412MHz, VP, 802.11n, 65Mbps @1m



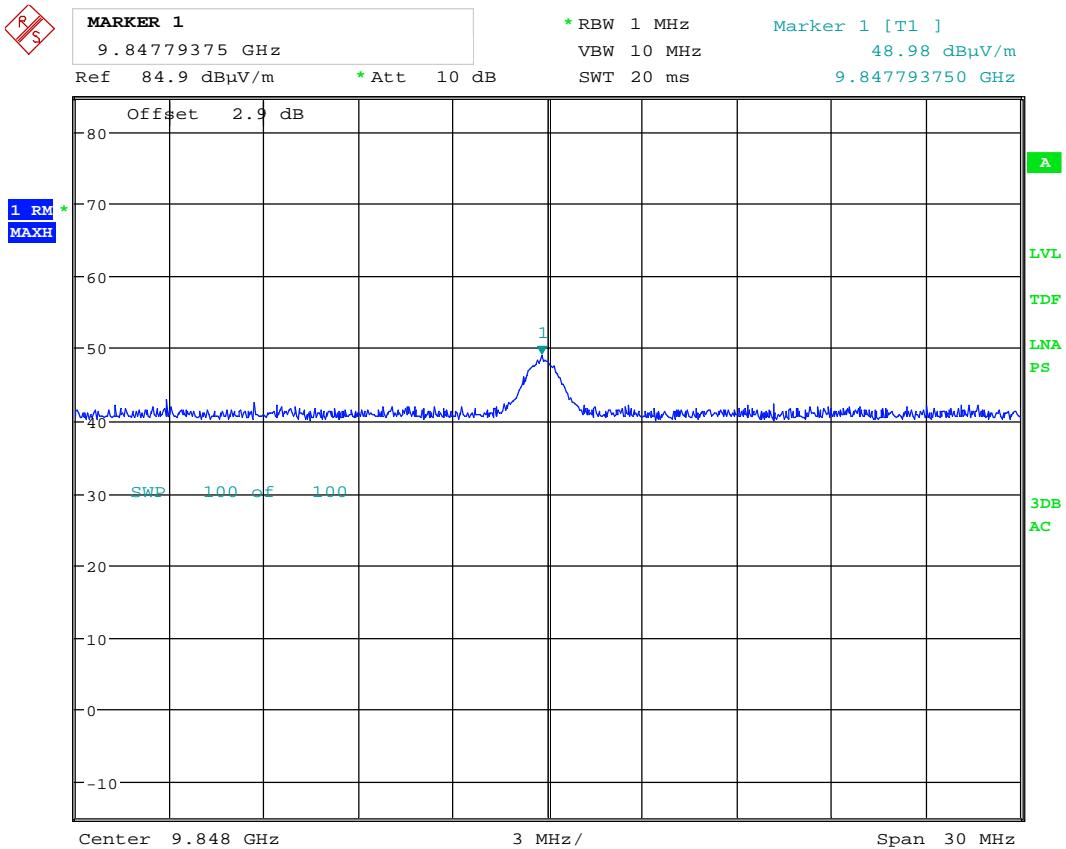
Date: 3.MAR.2016 13:46:10

4th har , RMS detector, 2412MHz, VP, 802.11n, 65Mbps @1m



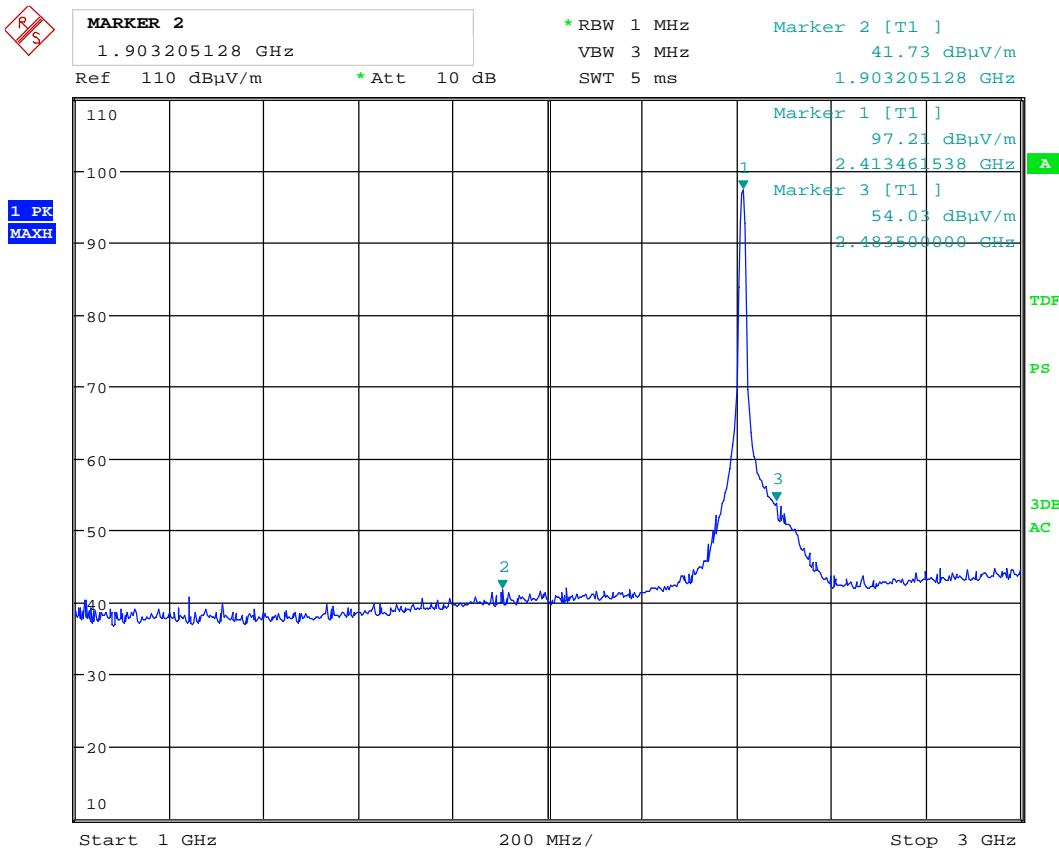
Date: 3.MAR.2016 13:49:35

4th har , PK detector, 2462MHz, VP, 802.11n, 65Mbps @1m



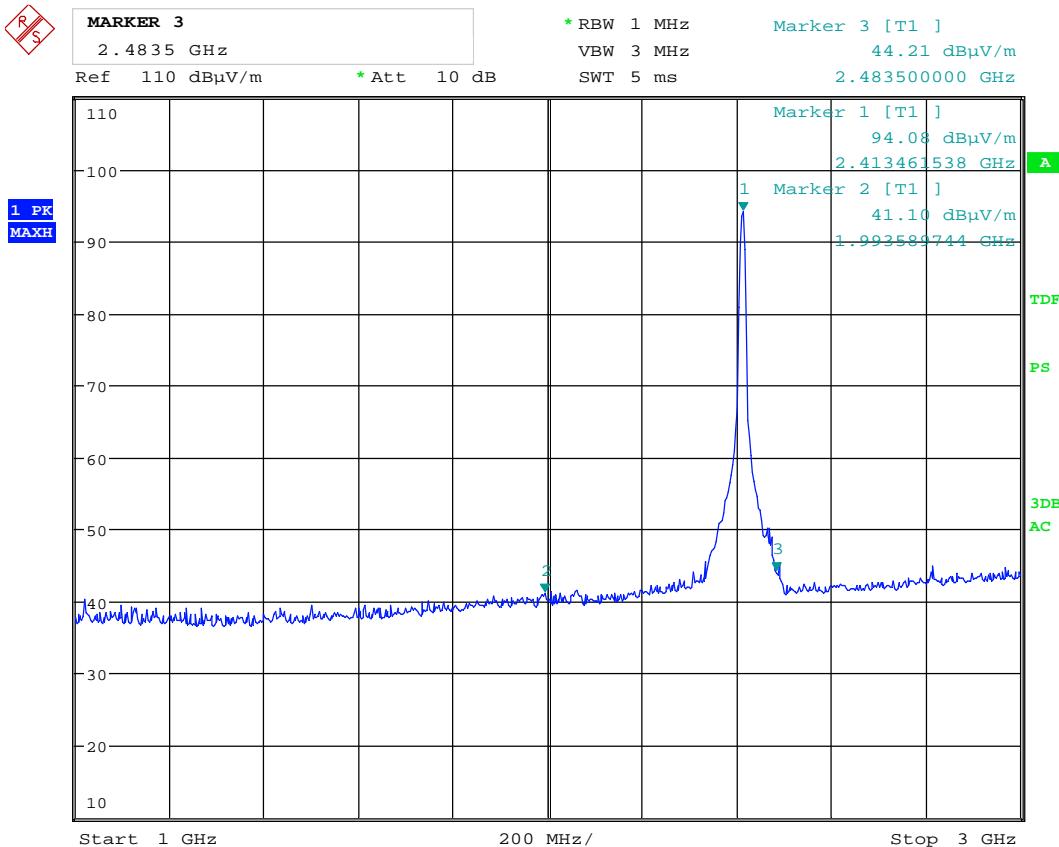
Date: 3.MAR.2016 13:48:55

4th har , RMS detector, 2462MHz, VP, 802.11n, 65Mbps @1m



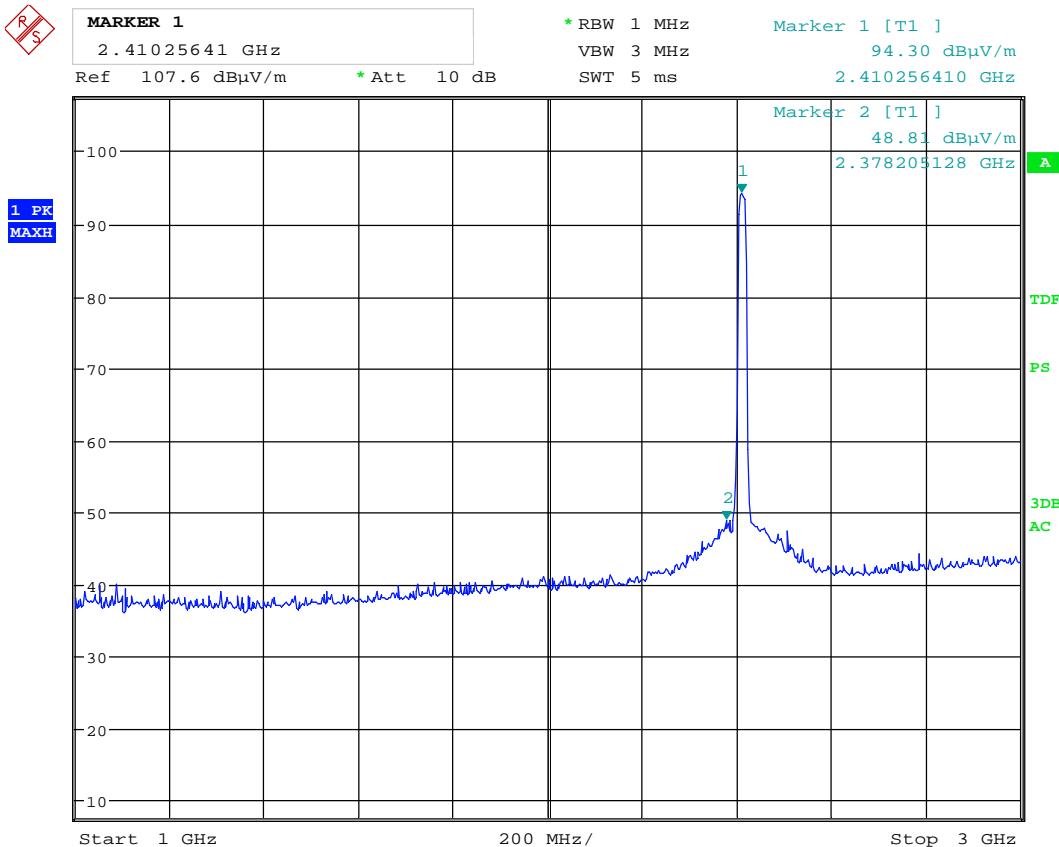
Date: 18.FEB.2016 11:17:59

Radiated Emissions, 2412 MHz, 1 - 3GHz, VP, 802.11b, 5.5Mbps



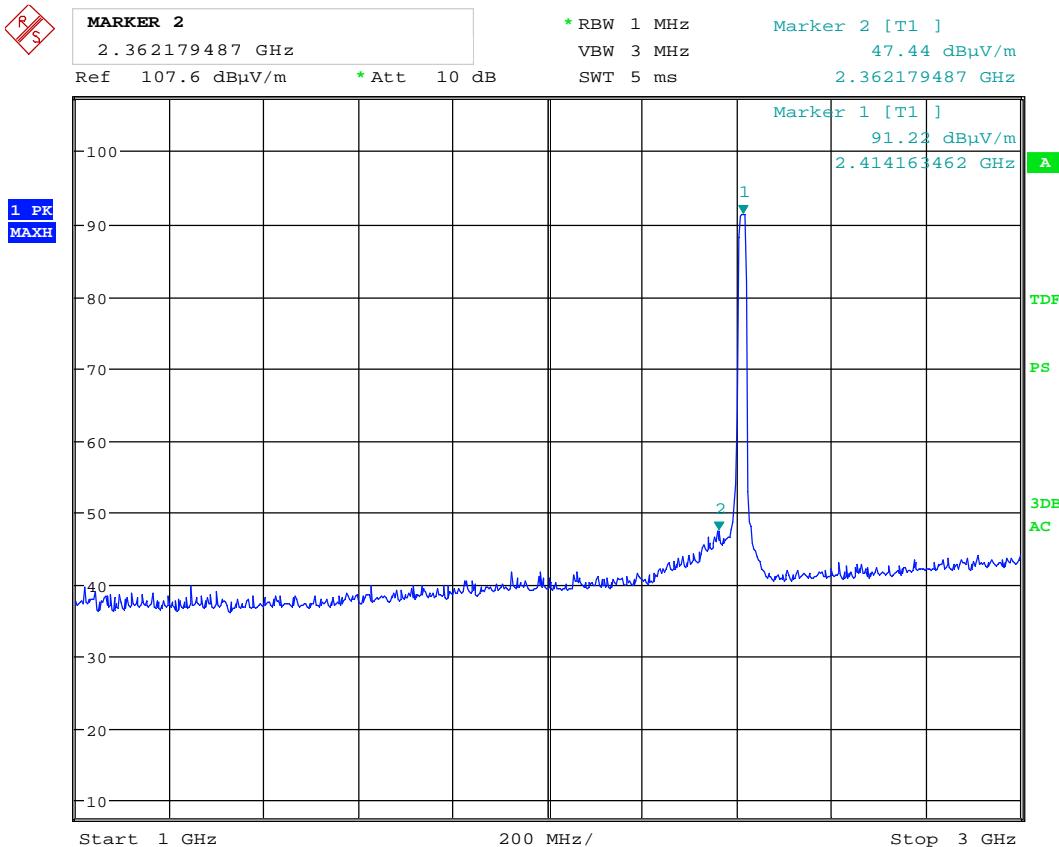
Date: 18.FEB.2016 12:55:23

Radiated Emissions, 2412MHz, 1 - 3GHz, HP, 802.11b, 5.5Mbps



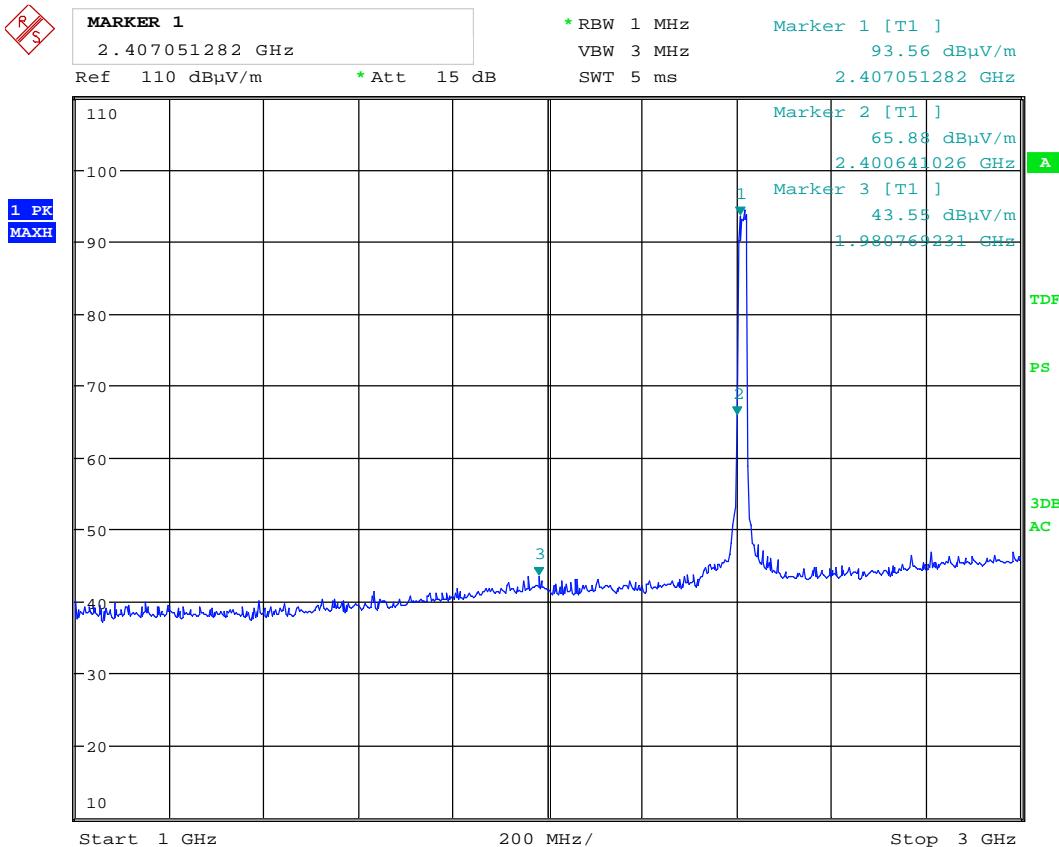
Date: 3.MAR.2016 11:19:52

Radiated Emissions, 2412MHz, 1 - 3GHz, VP, 802.11g, 9Mbps



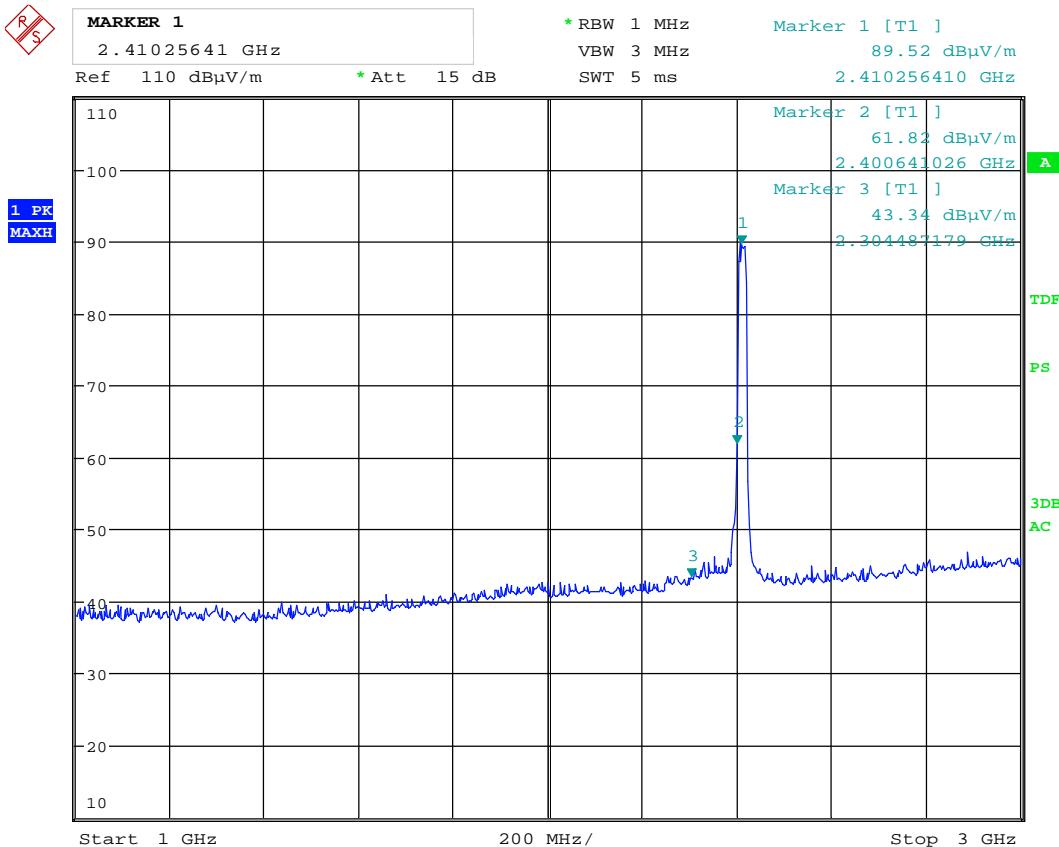
Date: 3.MAR.2016 11:57:28

Radiated Emissions, 2412MHz, 1 - 3GHz, HP, 802.11g, 9Mbps



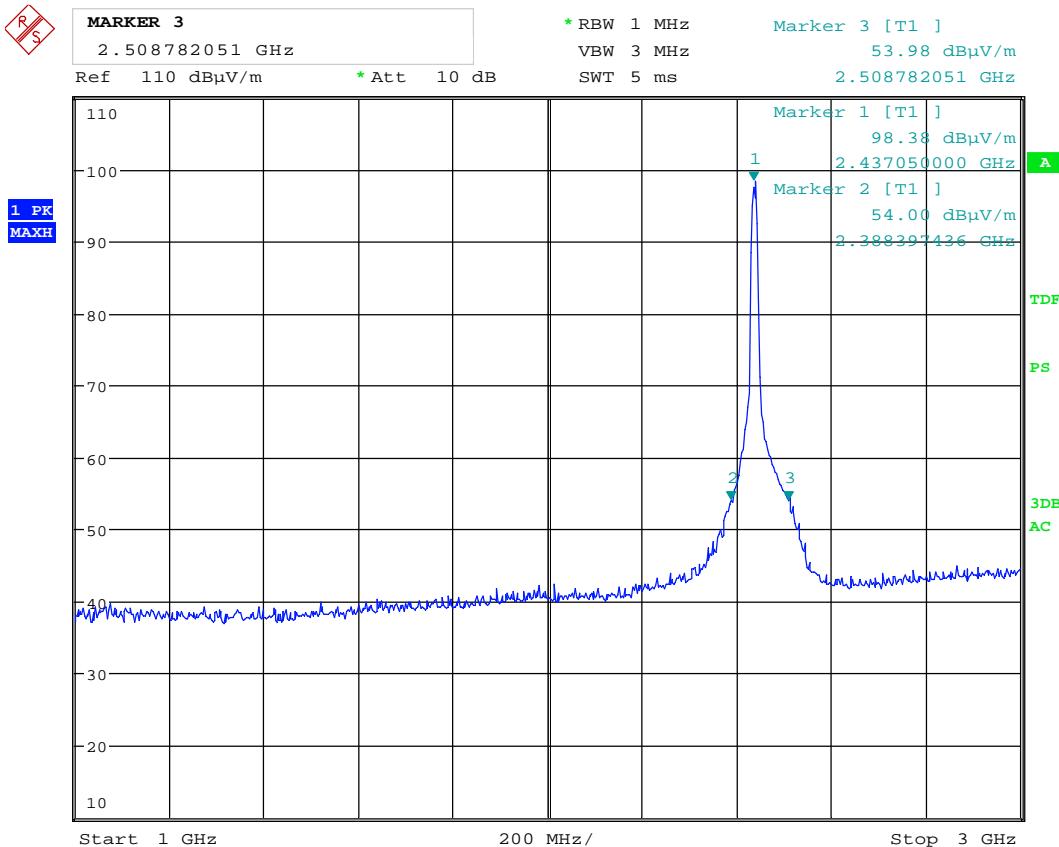
Date: 3.MAR.2016 08:56:24

Radiated Emissions, 2412MHz, 1 - 3GHz, VP, 802.11n, 65Mbps



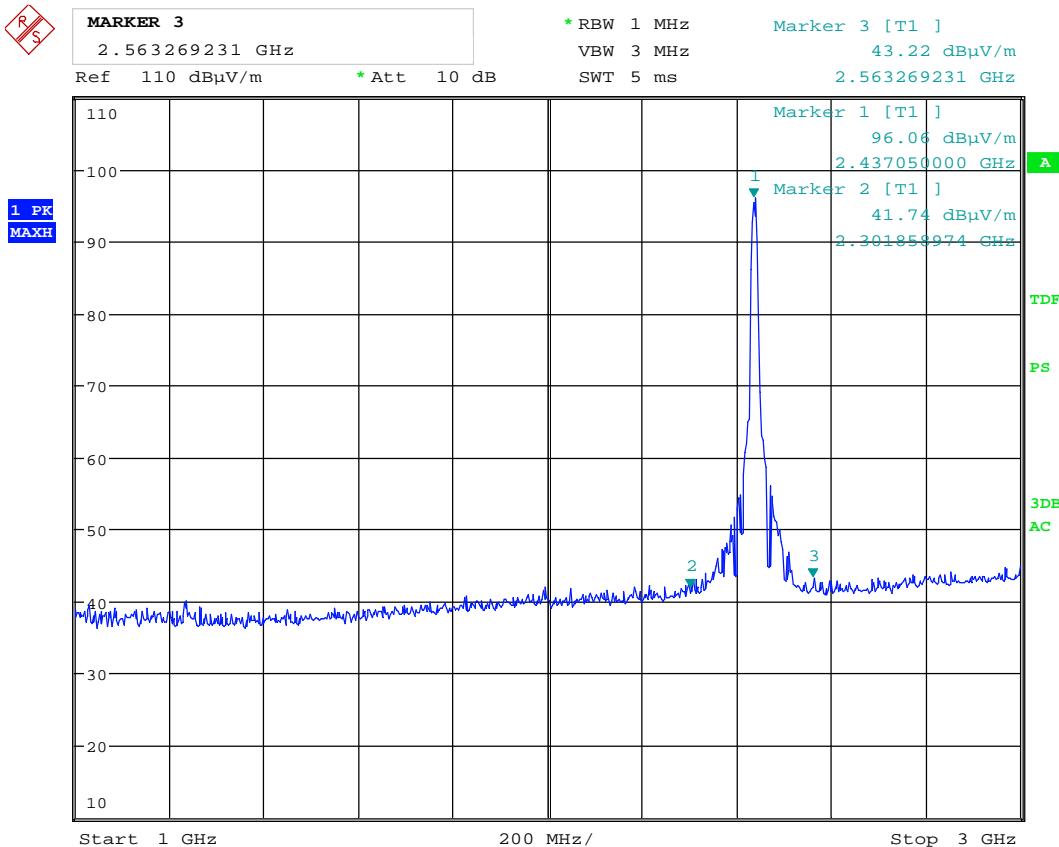
Date: 3.MAR.2016 08:54:46

Radiated Emissions, 2412MHz, 1 - 3GHz, HP, 802.11n, 65Mbps



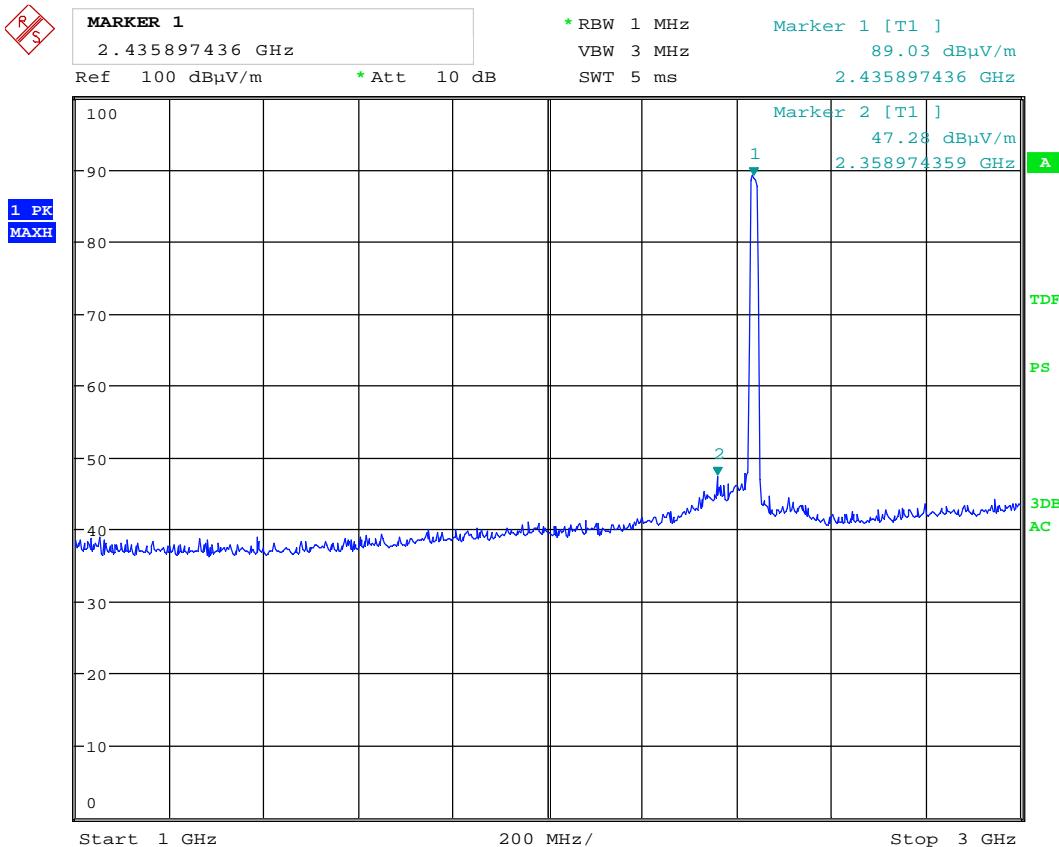
Date: 19.FEB.2016 07:50:40

Radiated Emissions, 2437MHz, 1 - 3GHz, VP, 802.11b, 5.5Mbps



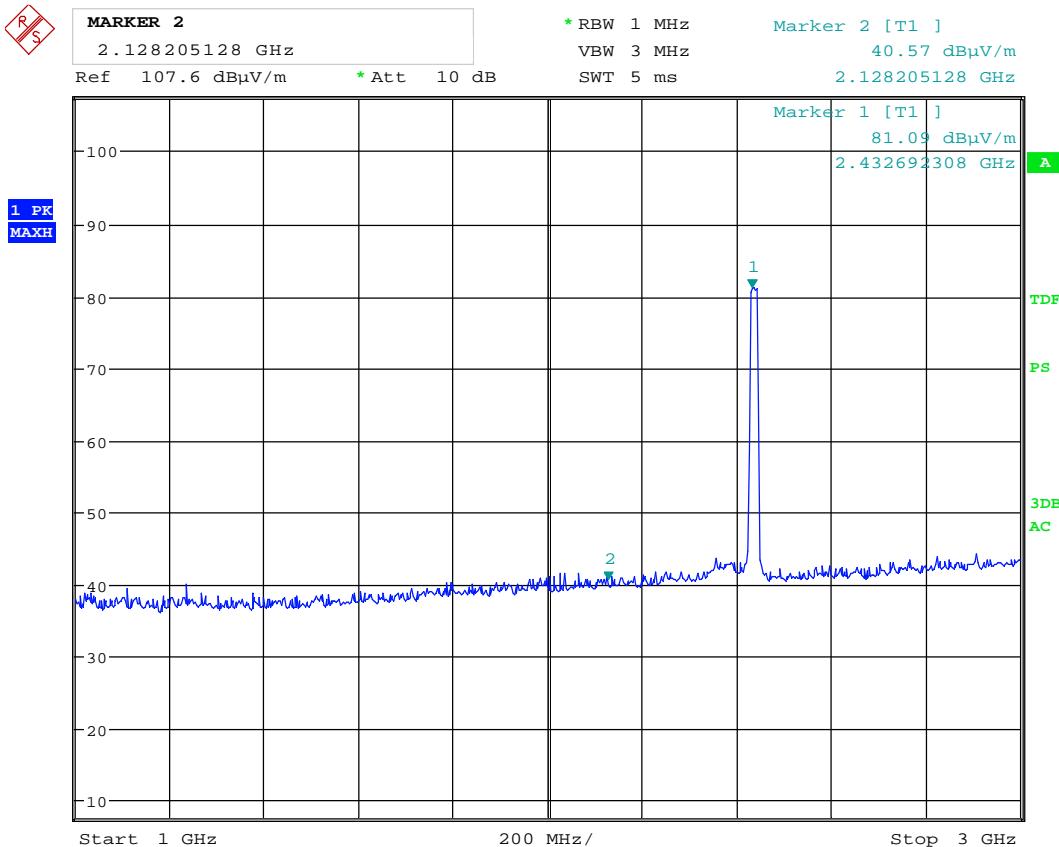
Date: 19.FEB.2016 07:47:15

Radiated Emissions, 2437MHz, 1 - 3GHz, HP, 802.11b, 5.5Mbps



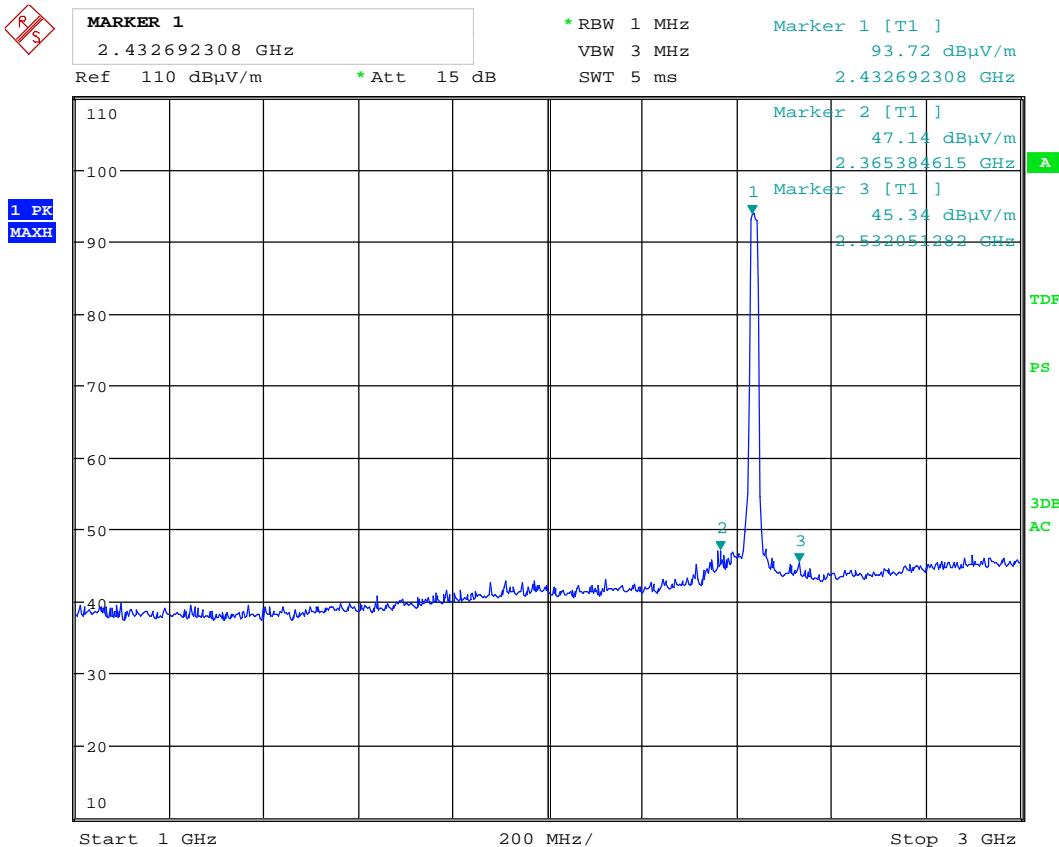
Date: 3.MAR.2016 12:26:30

Radiated Emissions, 2437MHz, 1 - 3GHz, VP, 802.11g, 9Mbps



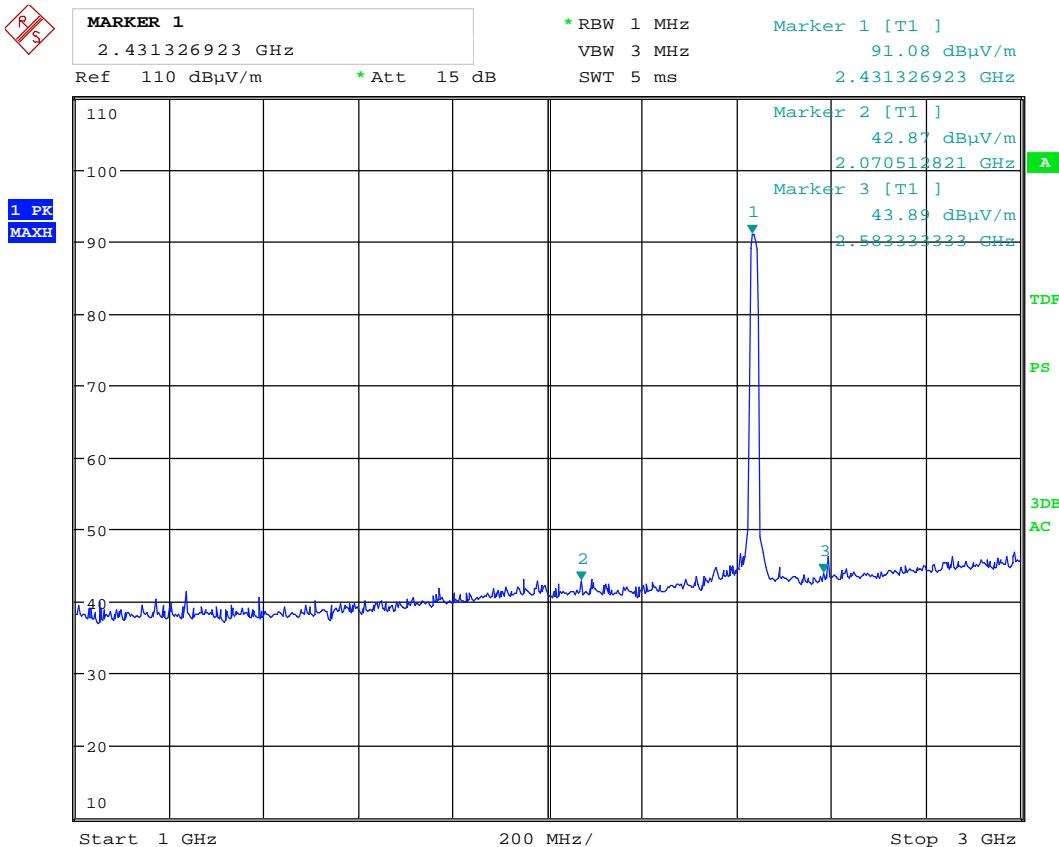
Date: 3.MAR.2016 12:24:41

Radiated Emissions, 2437MHz, 1 - 3GHz, HP, 802.11g, 9Mbps



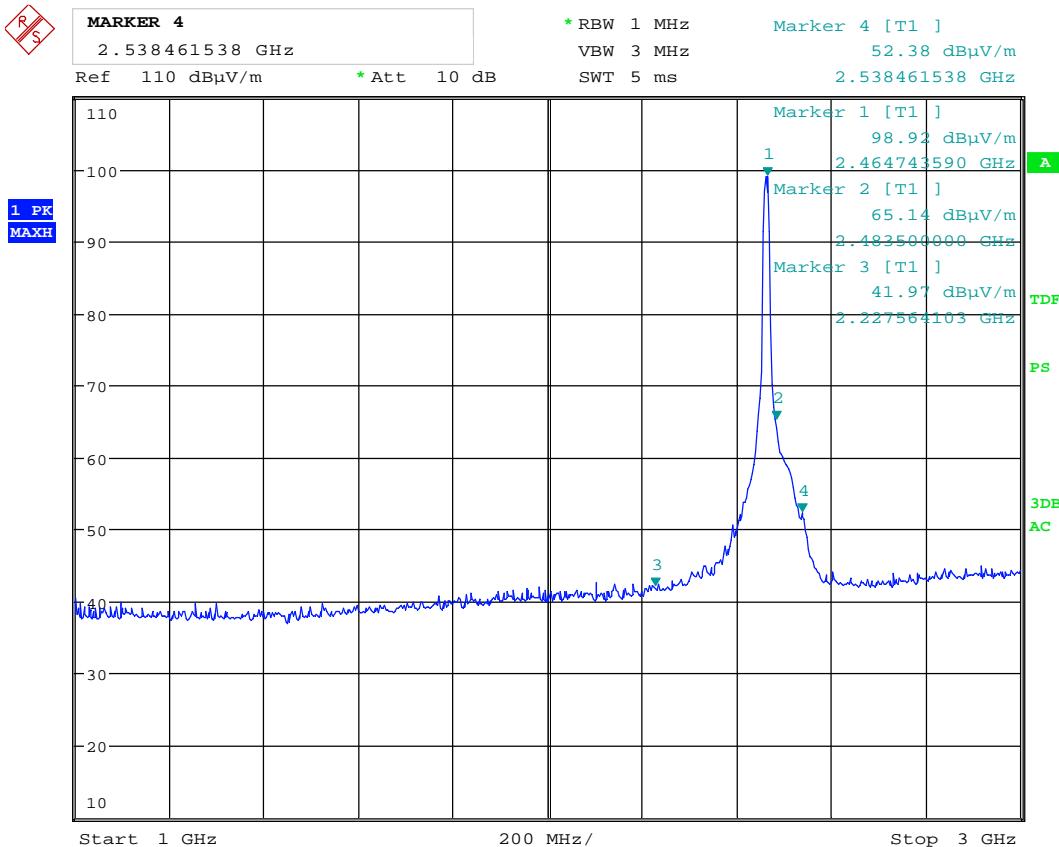
Date: 3.MAR.2016 08:29:22

Radiated Emissions, 2437MHz, 1 - 3GHz, VP, 802.11n, 65Mbps



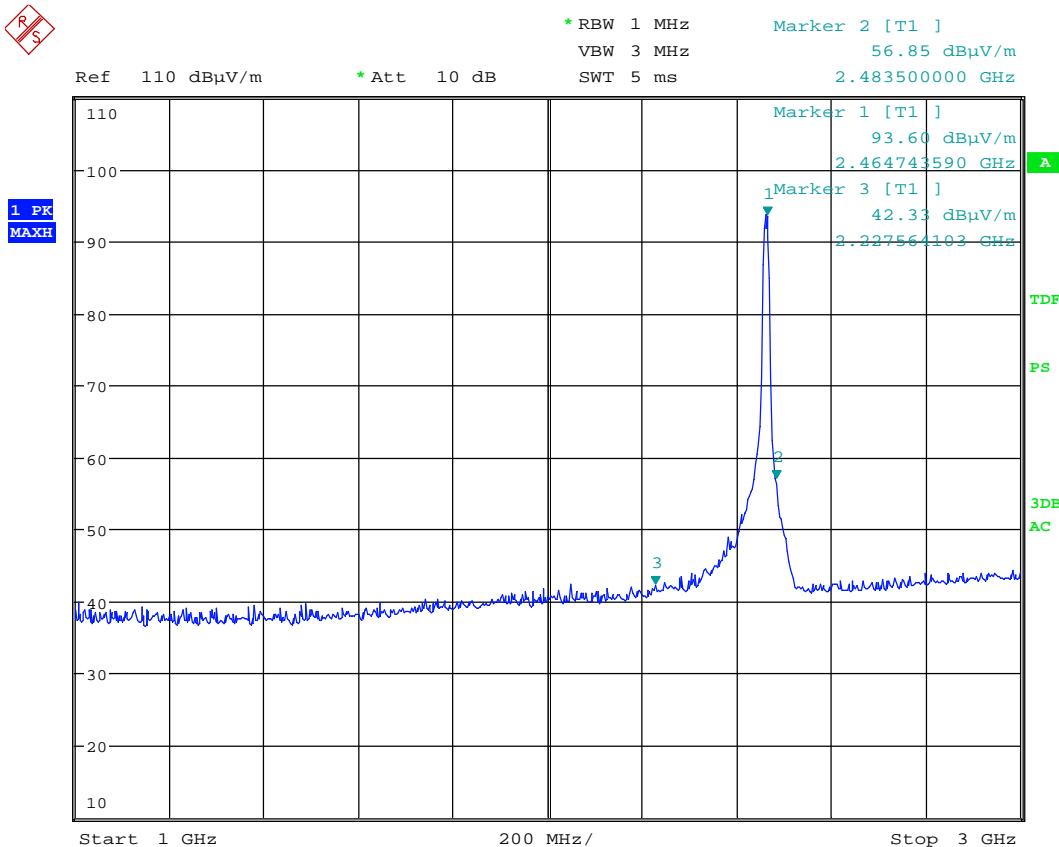
Date: 3.MAR.2016 08:28:10

Radiated Emissions, 2437MHz, 1 - 3GHz, HP, 802.11n, 65Mbps



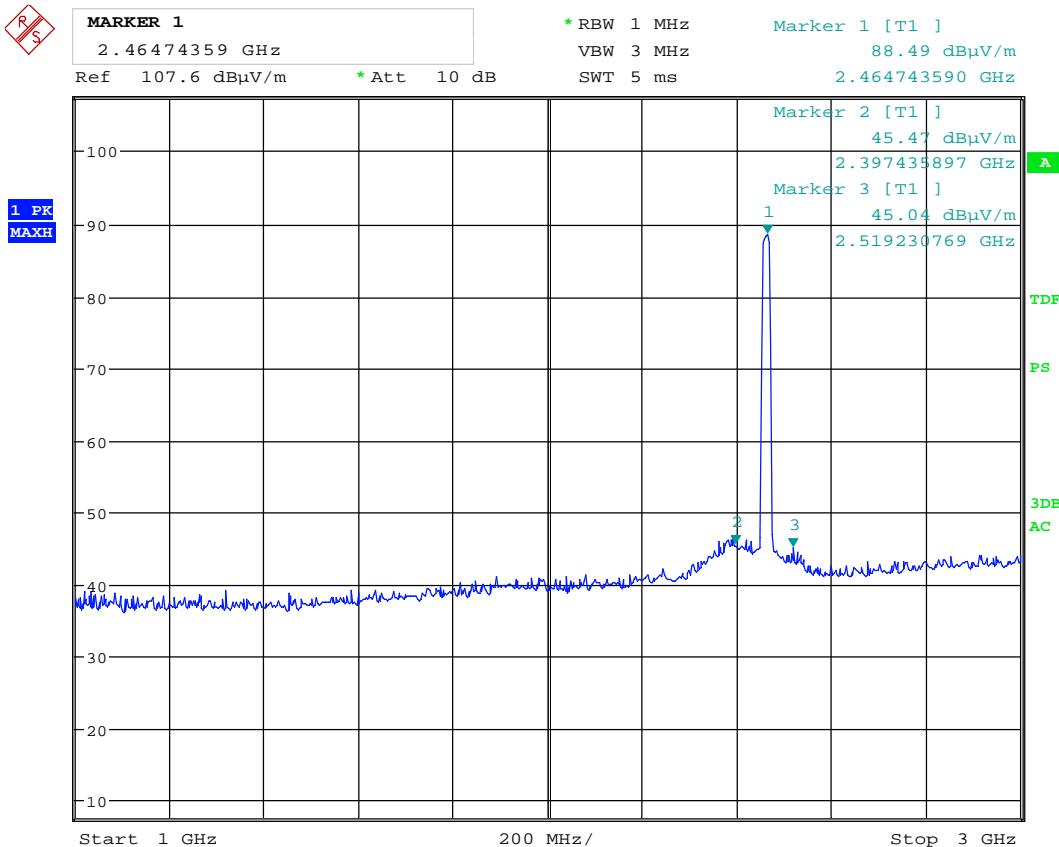
Date: 19.FEB.2016 06:57:36

Radiated Emissions, 2462MHz, 1 - 3GHz, VP, 802.11b, 5.5Mbps



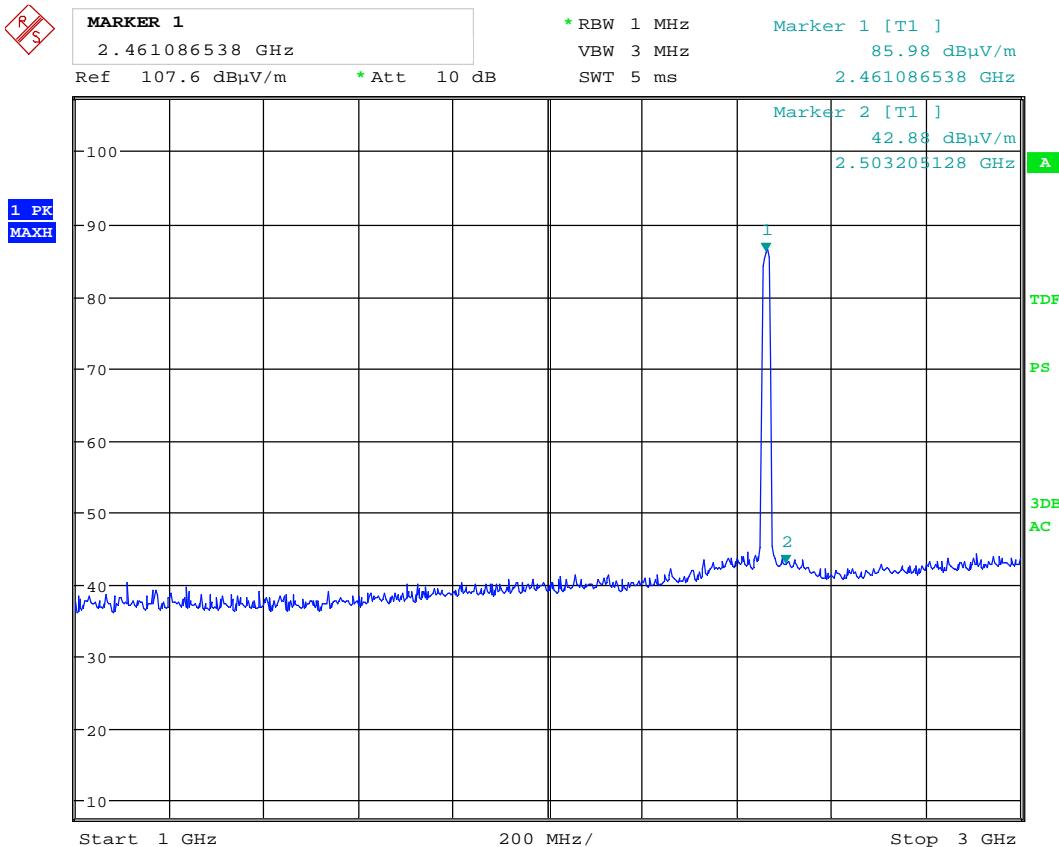
Date: 19.FEB.2016 06:55:46

Radiated Emissions, 2462MHz, 1 - 3GHz, HP, 802.11b, 5.5Mbps



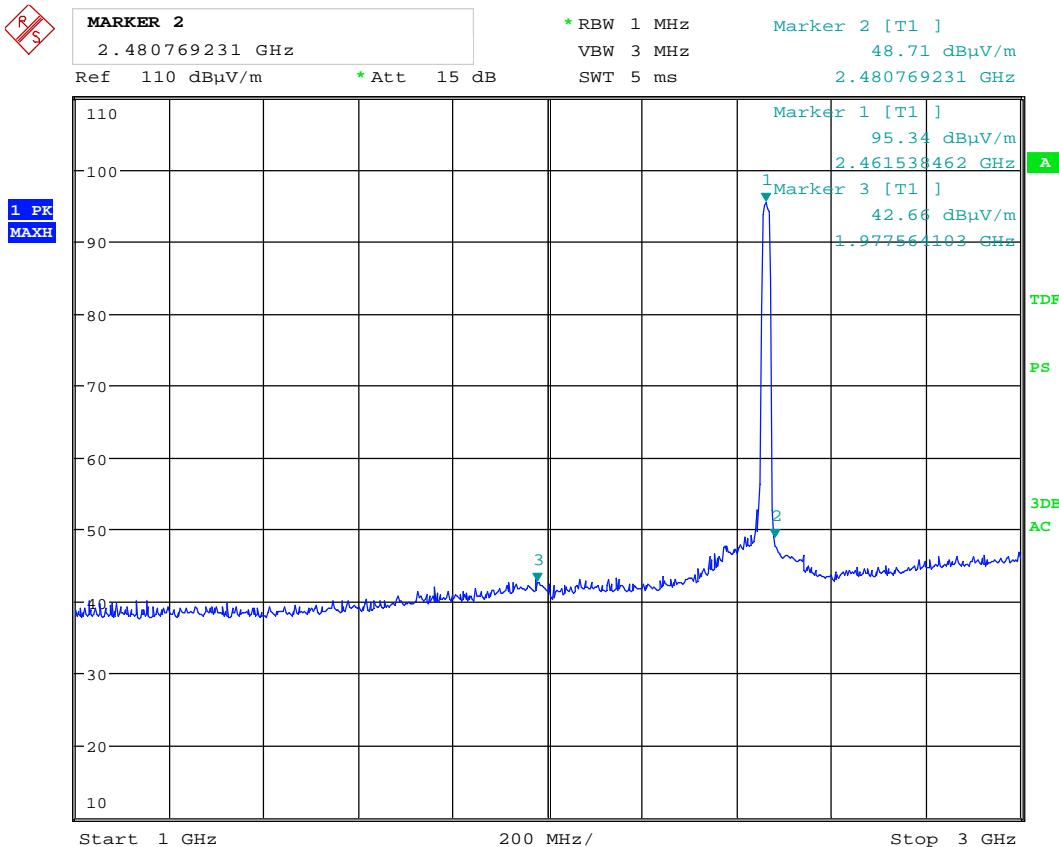
Date: 3.MAR.2016 11:06:34

Radiated Emissions, 2462MHz, 1 - 3GHz, VP, 802.11g, 9Mbps



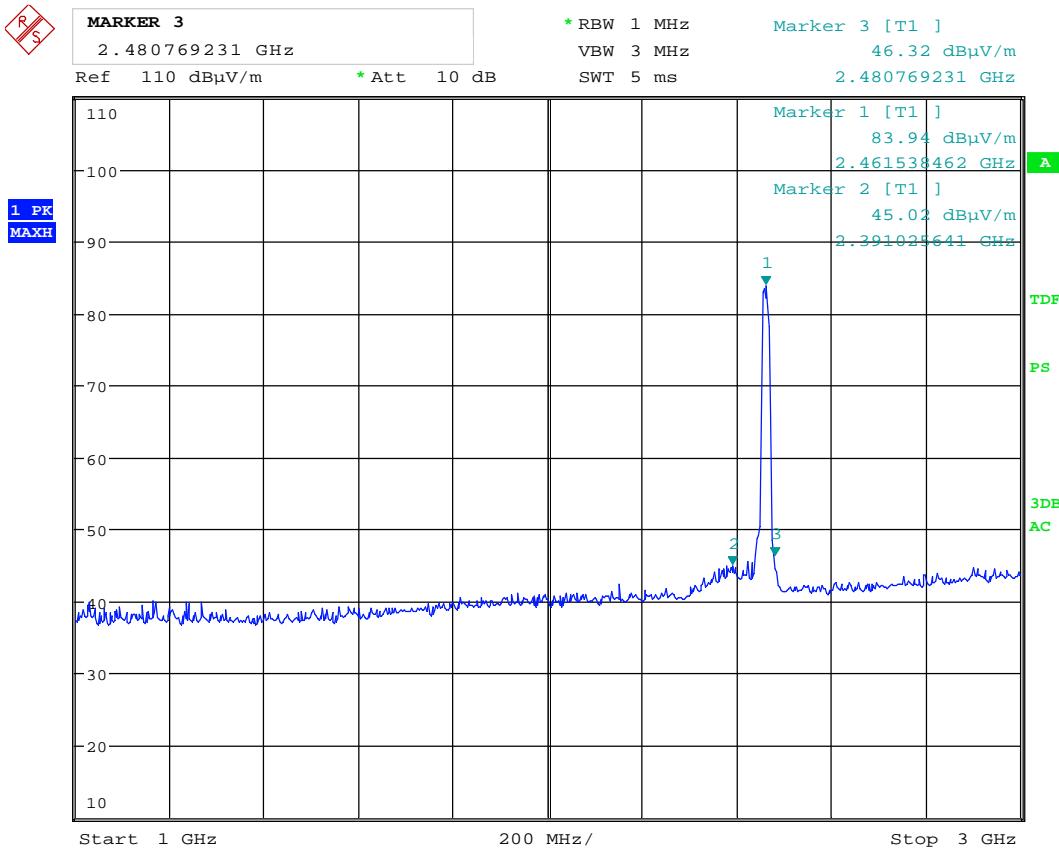
Date: 3.MAR.2016 11:09:55

Radiated Emissions, 2462MHz, 1 - 3GHz, HP, 802.11g, 9Mbps



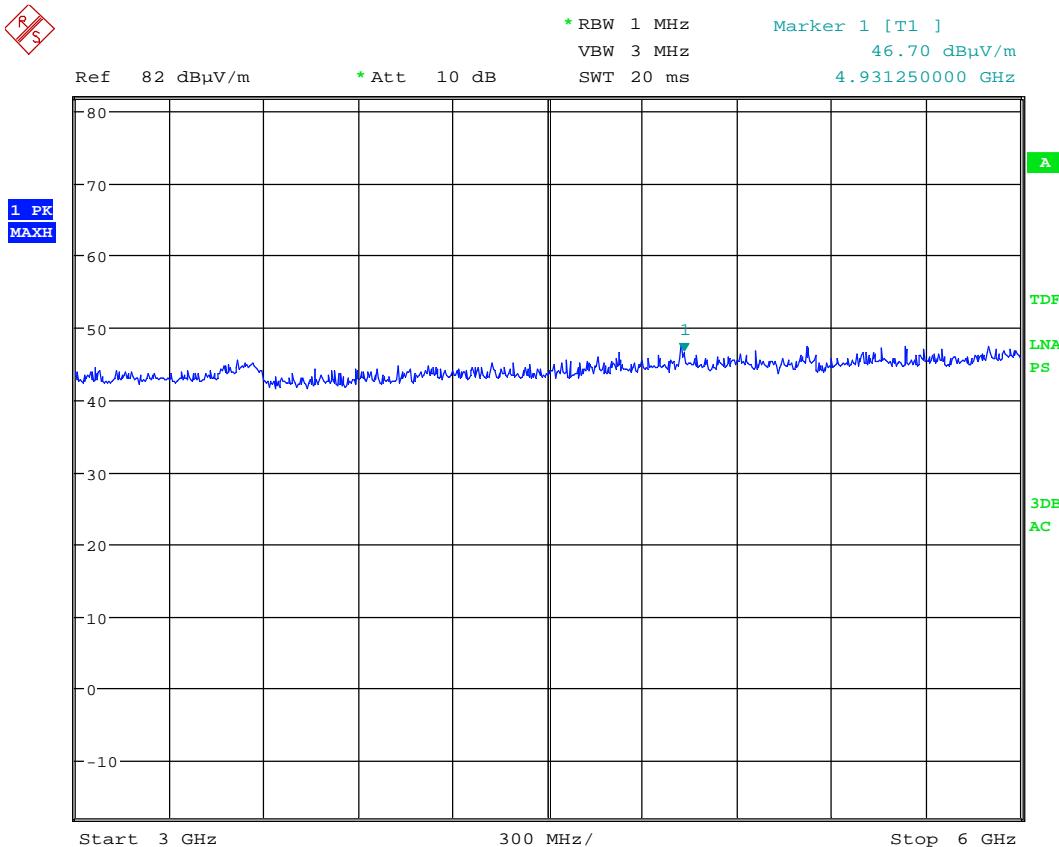
Date: 3.MAR.2016 07:51:48

Radiated Emissions, 2462MHz, 1 - 3GHz, VP, 802.11n, 65Mbps



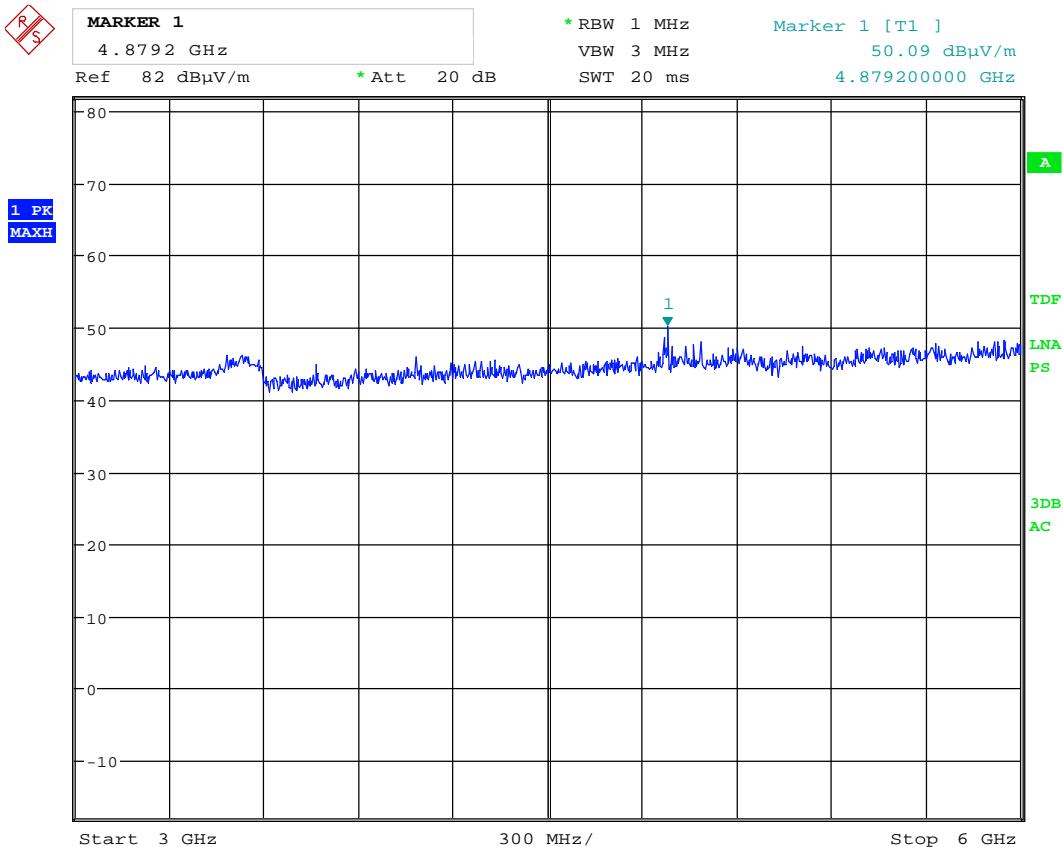
Date: 3.MAR.2016 08:01:30

Radiated Emissions, 2462MHz, 1 - 3GHz, HP, 802.11n, 65Mbps



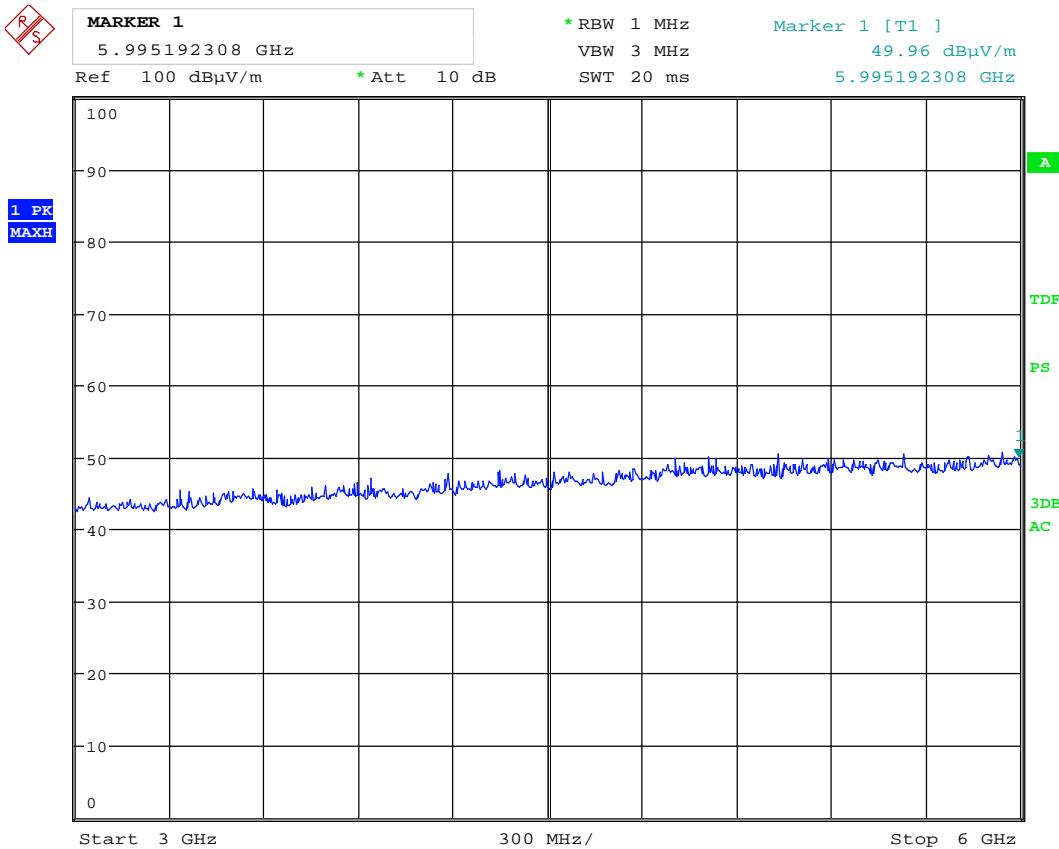
Date: 19.FEB.2016 07:16:11

Radiated Emissions, 3 - 6GHz, 2412MHz, VP, 802.11b, 5.5Mbps



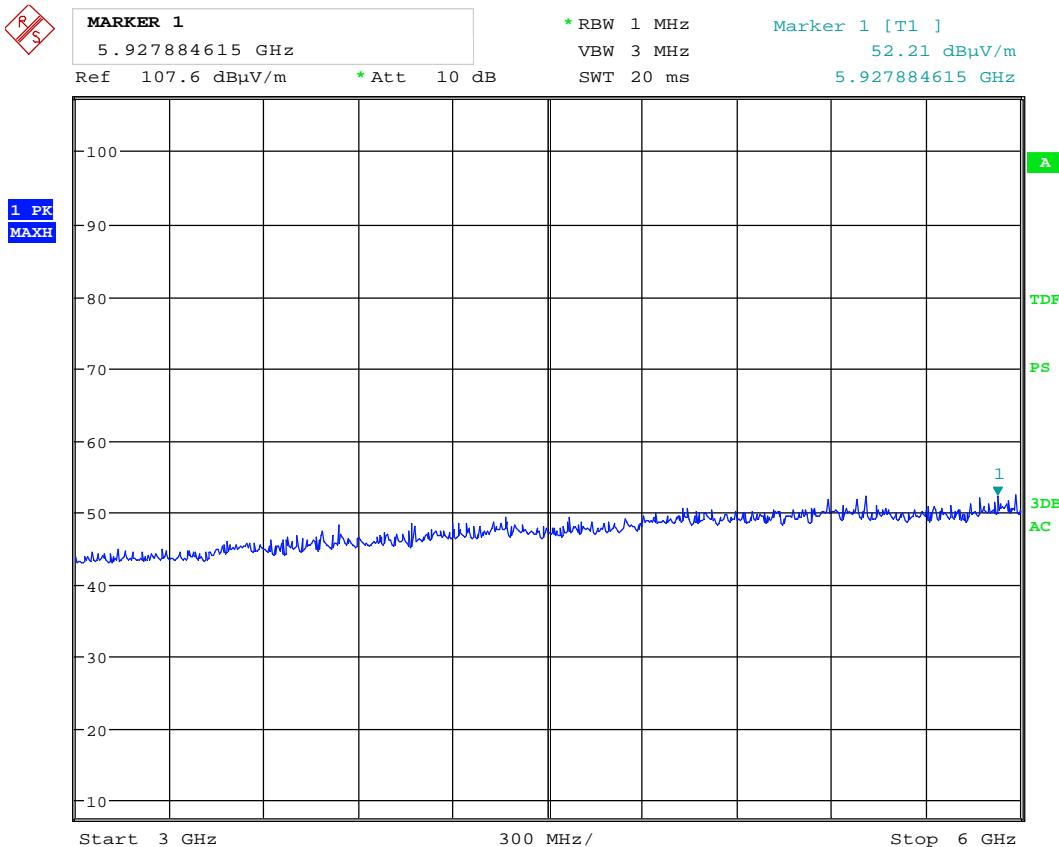
Date: 19.FEB.2016 07:58:22

Radiated Emissions, 3 - 6GHz, 2412MHz, HP, 802.11b, 5.5Mbps



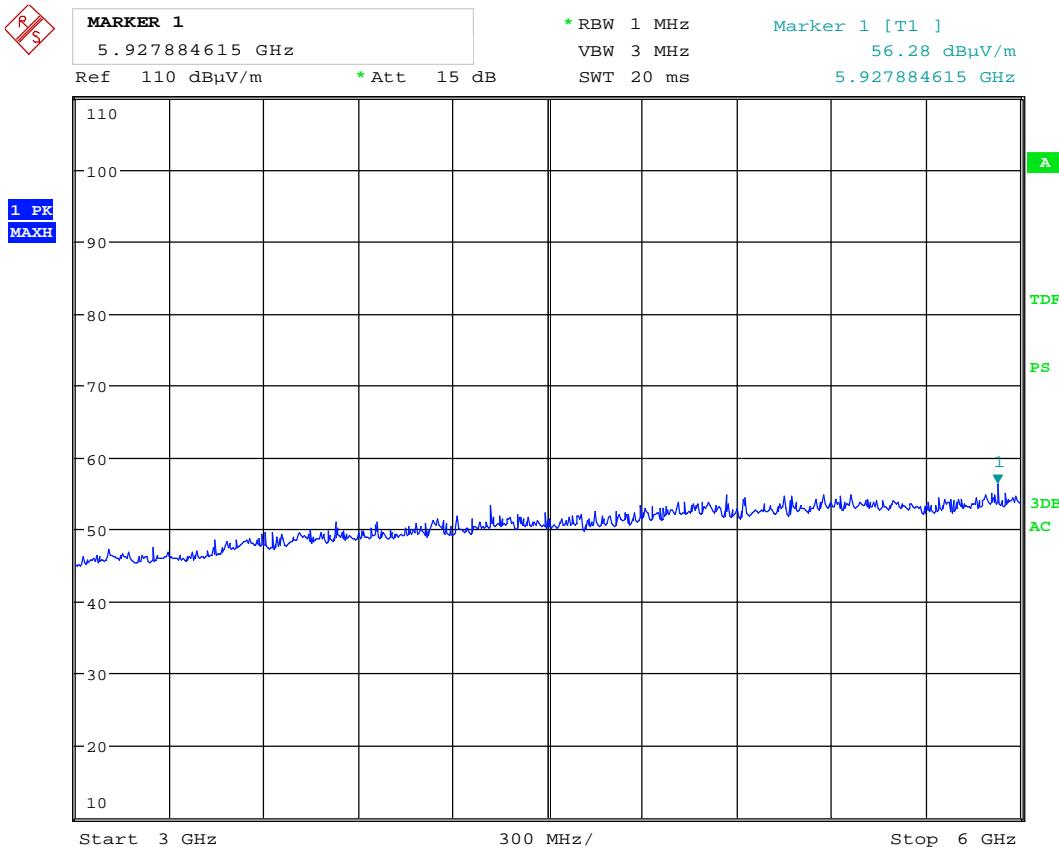
Date: 3.MAR.2016 12:33:52

Radiated Emissions, 3 - 6GHz, 2412MHz, VP, 802.11g, 9Mbps



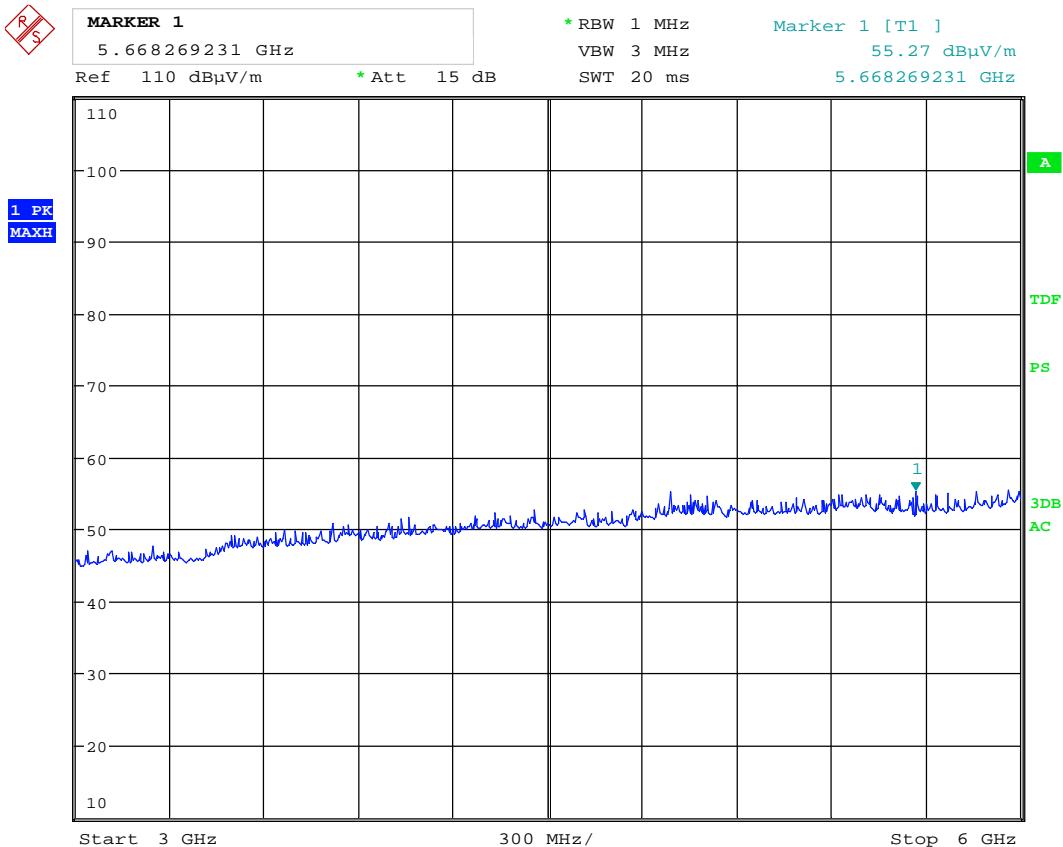
Date: 3.MAR.2016 11:58:04

Radiated Emissions, 3 - 6GHz, 2412MHz, HP, 802.11g, 9Mbps



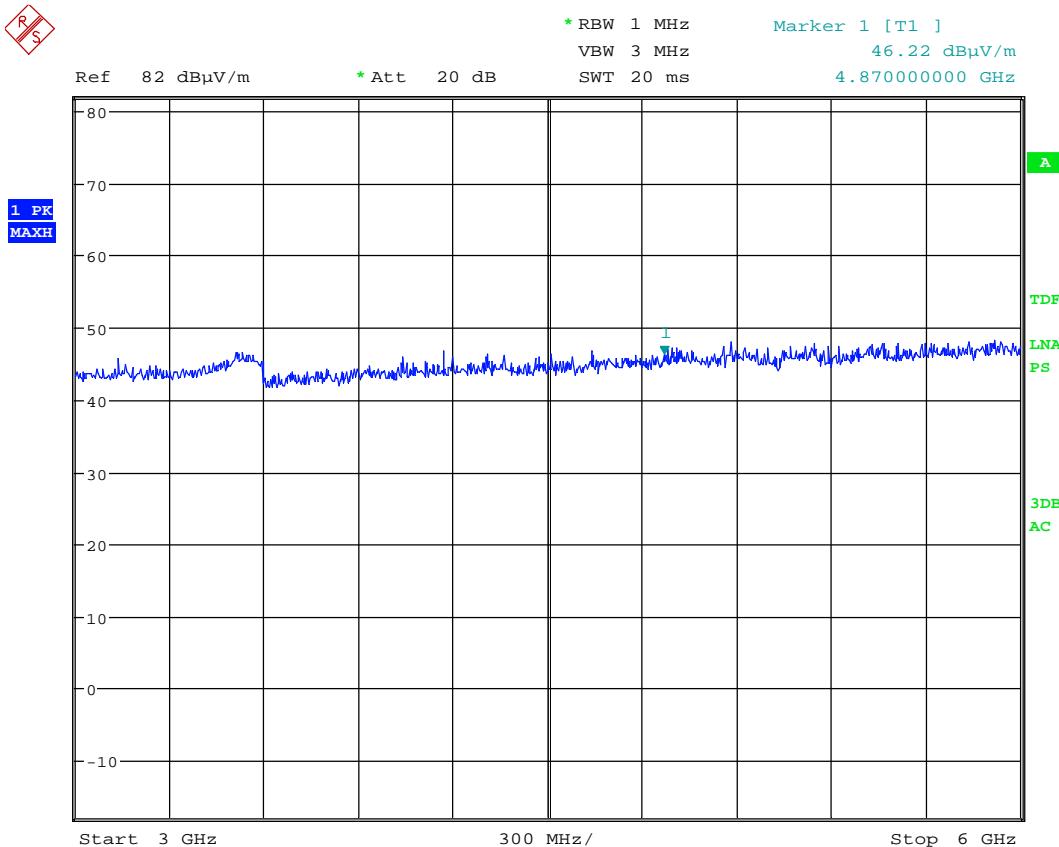
Date: 3.MAR.2016 09:24:20

Radiated Emissions, 3 - 6GHz, 2412MHz, VP, 802.11n, 65Mbps



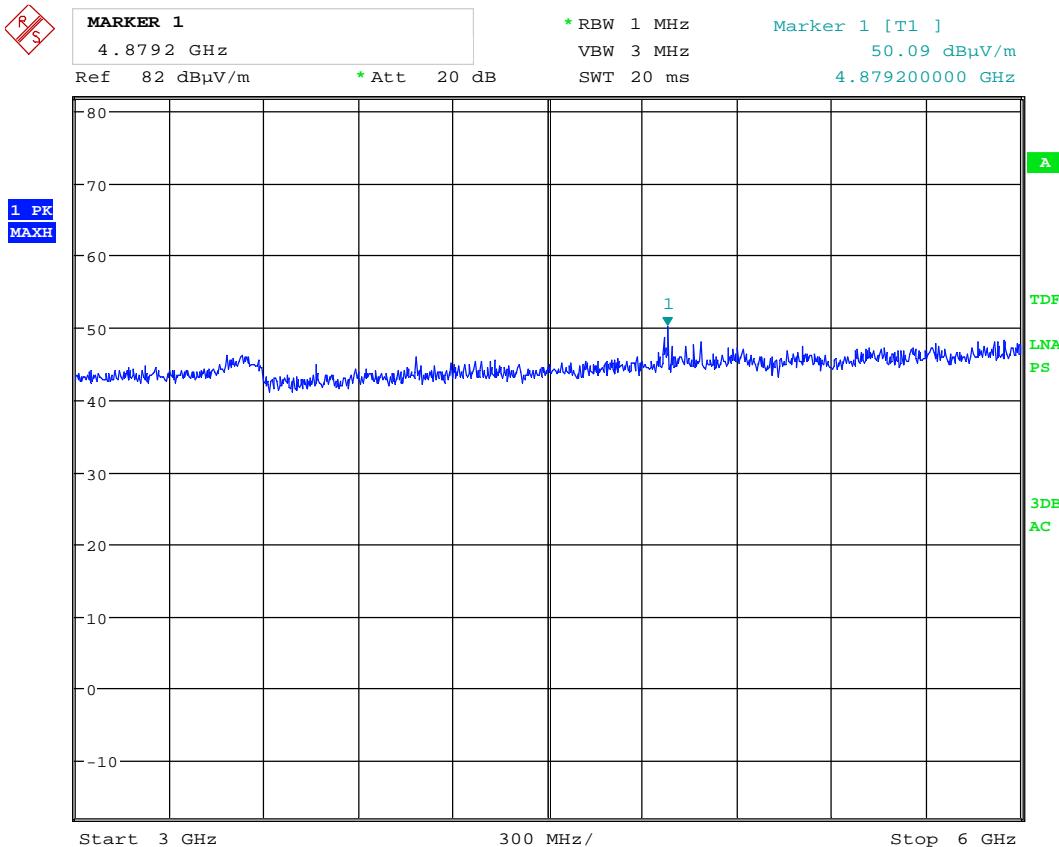
Date: 3.MAR.2016 09:25:04

Radiated Emissions, 3 - 6GHz, 2412MHz, HP, 802.11n, 65Mbps



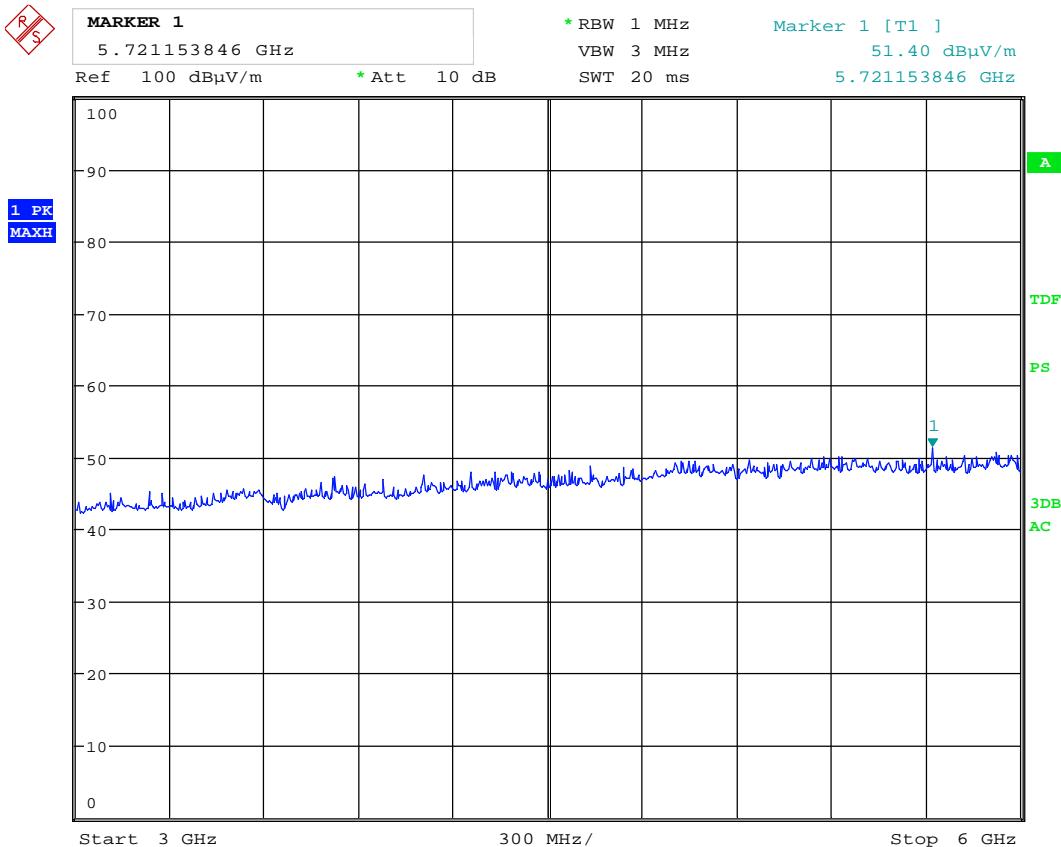
Date: 19.FEB.2016 08:01:25

Radiated Emissions, 3 - 6GHz, 2437MHz, VP, 802.11b, 5.5Mbps



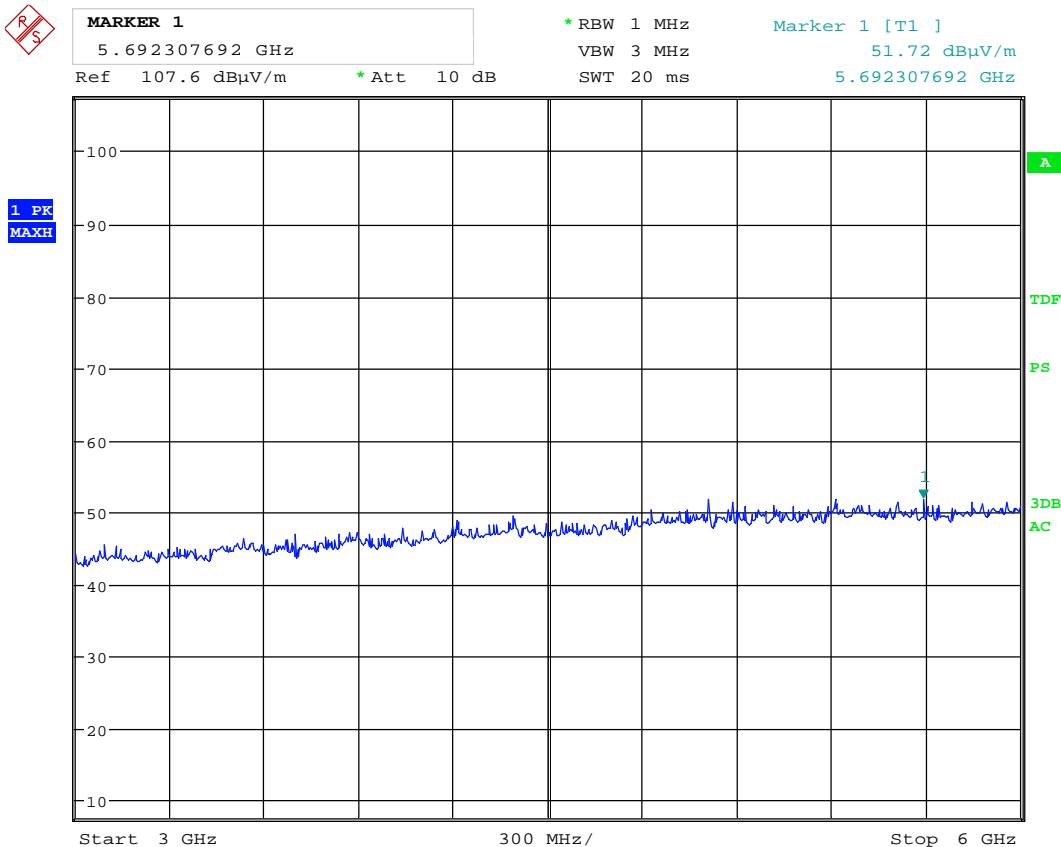
Date: 19.FEB.2016 07:58:22

Radiated Emissions, 3 - 6GHz, 2437MHz, HP, 802.11b, 5.5Mbps



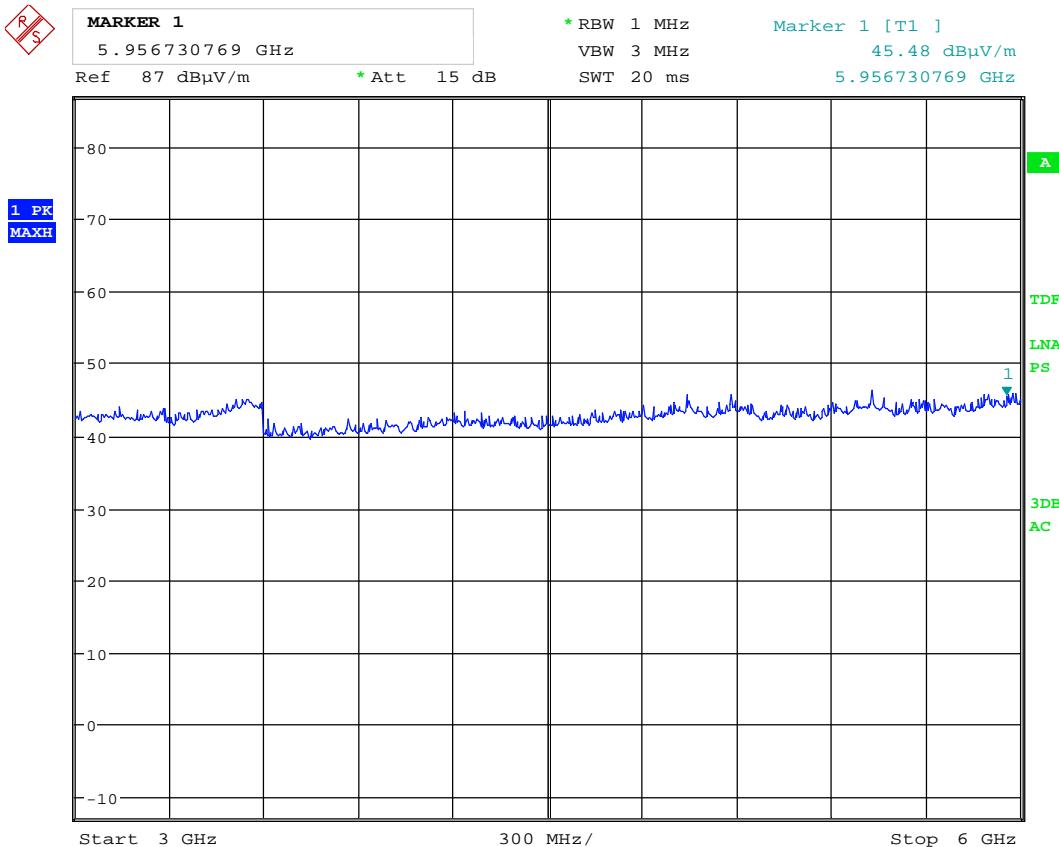
Date: 3.MAR.2016 12:28:24

Radiated Emissions, 3 - 6GHz, 2437MHz, VP, 802.11g, 9Mbps



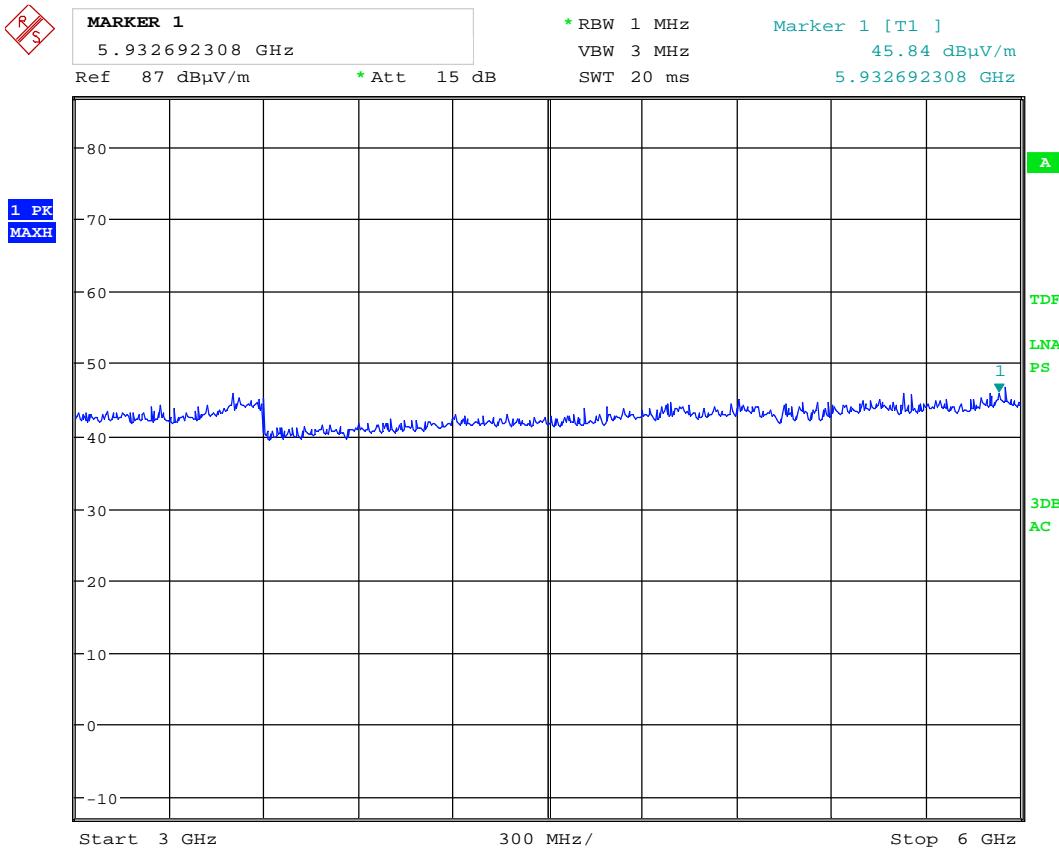
Date: 3.MAR.2016 12:25:14

Radiated Emissions, 3 - 6GHz, 2437MHz, HP, 802.11g, 9Mbps



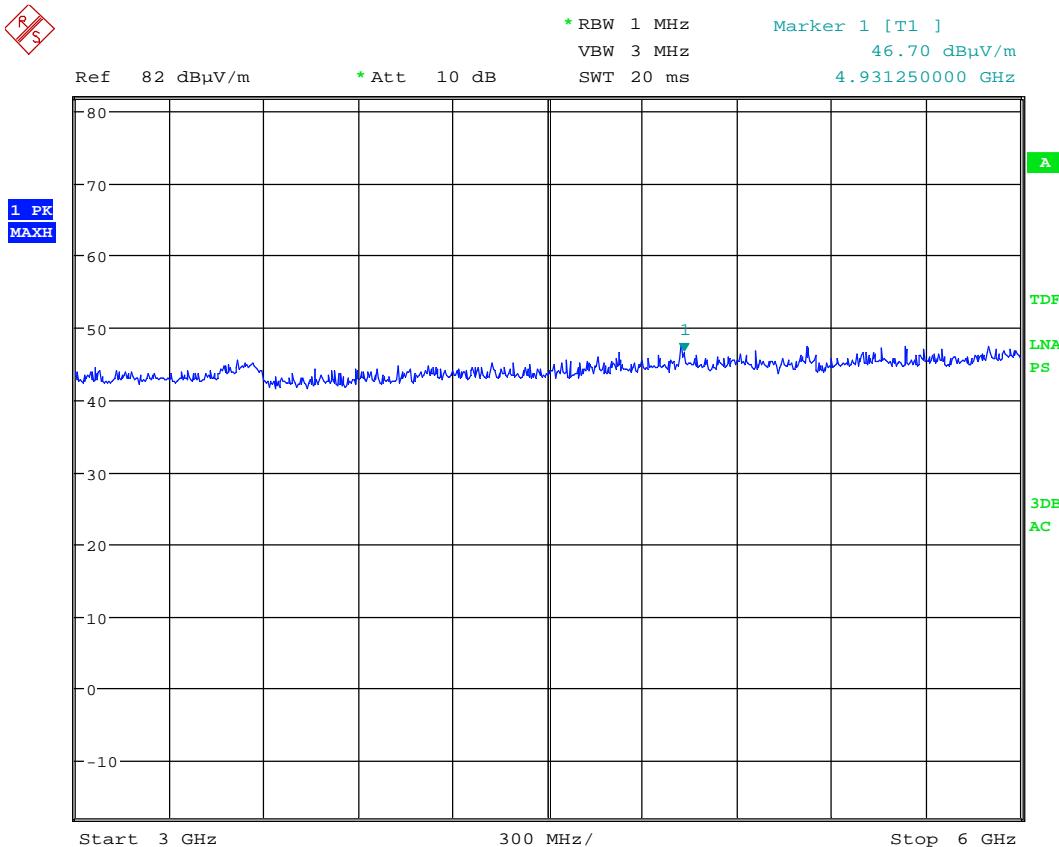
Date: 3.MAR.2016 08:41:00

Radiated Emissions, 3 - 6GHz, 2437MHz, VP, 802.11n, 65Mbps



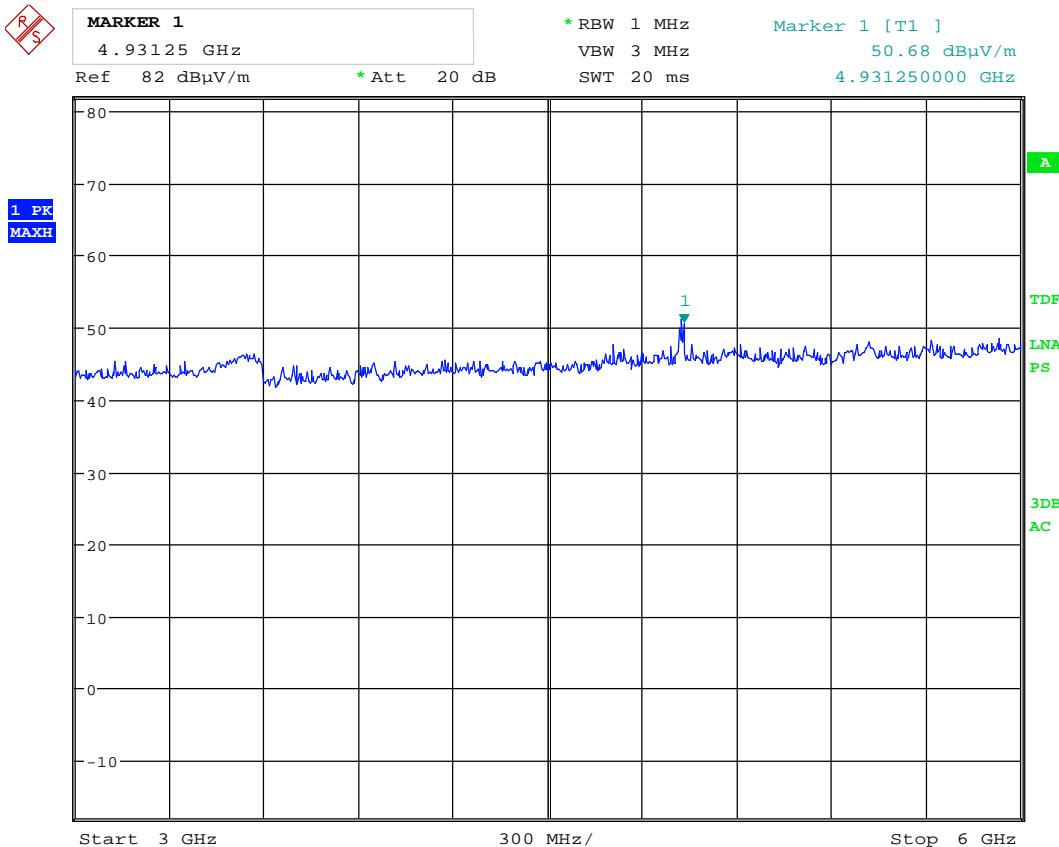
Date: 3.MAR.2016 08:42:07

Radiated Emissions, 3 - 6GHz, 2437MHz, HP, 802.11n, 65Mbps



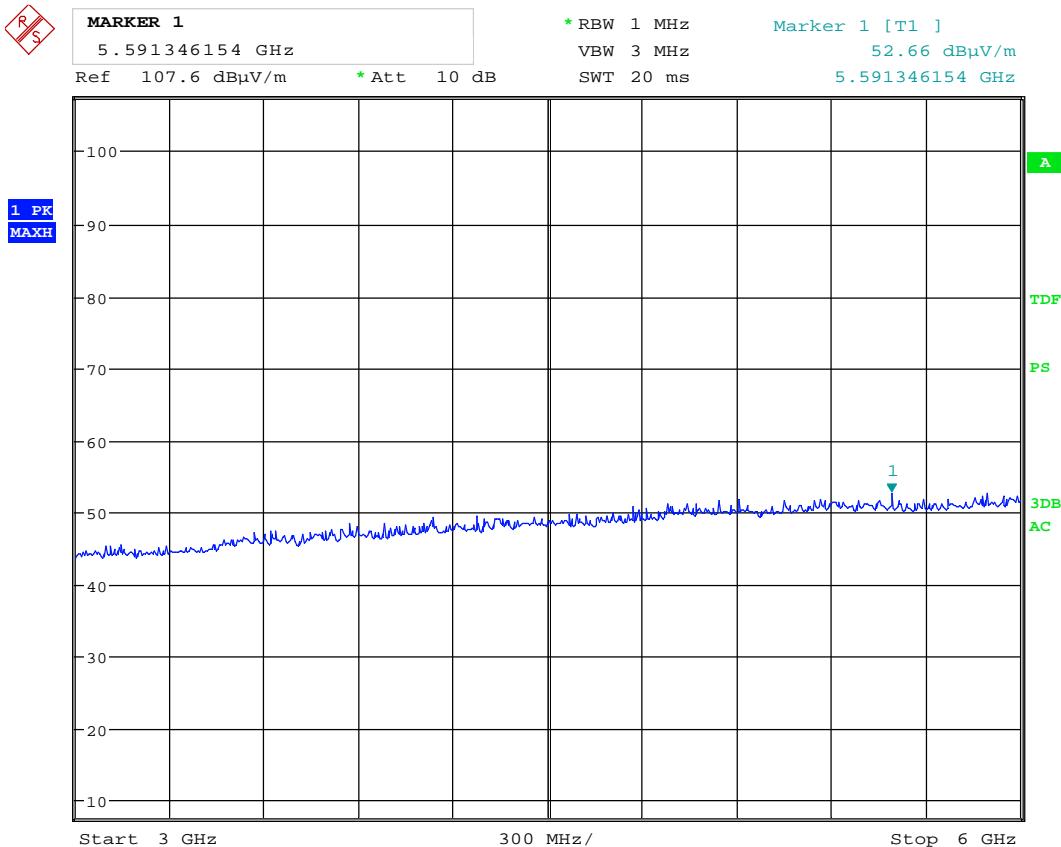
Date: 19.FEB.2016 07:16:11

Radiated Emissions, 3 - 6GHz, 2462MHz, VP, 802.11b, 5.5Mbps



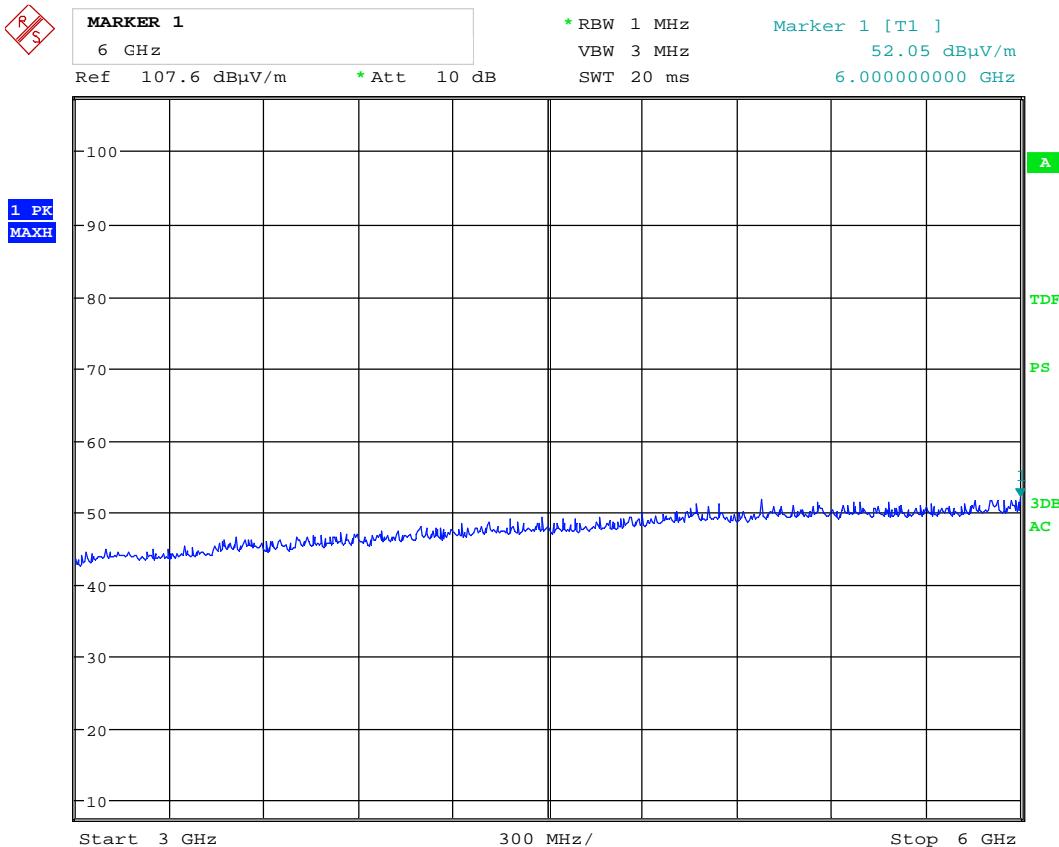
Date: 19.FEB.2016 07:14:11

Radiated Emissions, 3 - 6GHz, 2462MHz, HP, 802.11b, 5.5Mbps



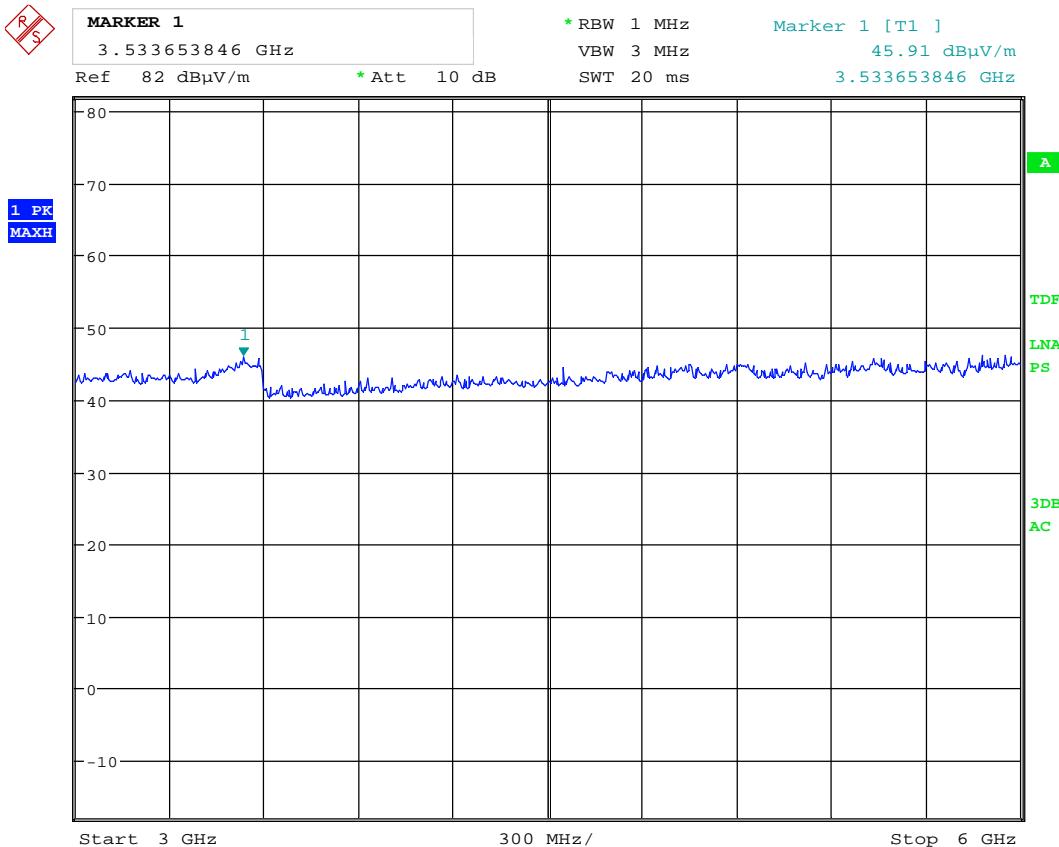
Date: 3.MAR.2016 11:12:31

Radiated Emissions, 3 - 6GHz, 2462MHz, VP, 802.11g, 9Mbps



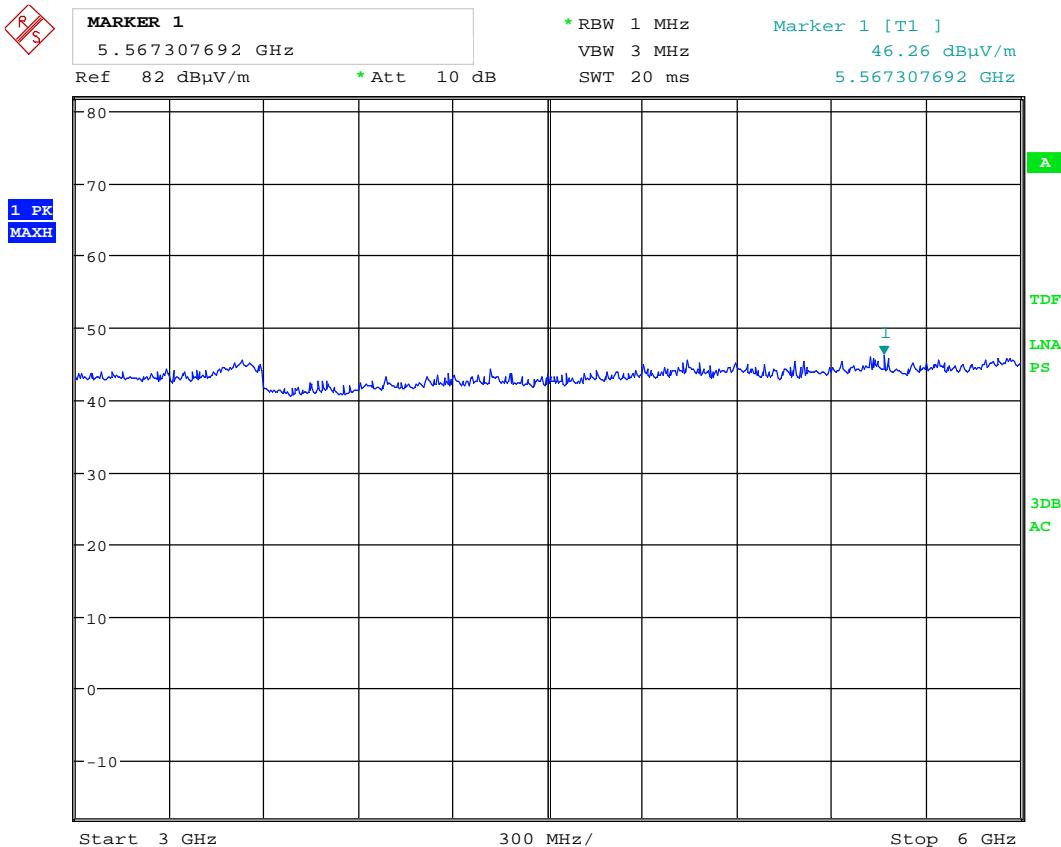
Date: 3.MAR.2016 11:10:44

Radiated Emissions, 3 - 6GHz, 2462MHz, HP, 802.11g, 9Mbps



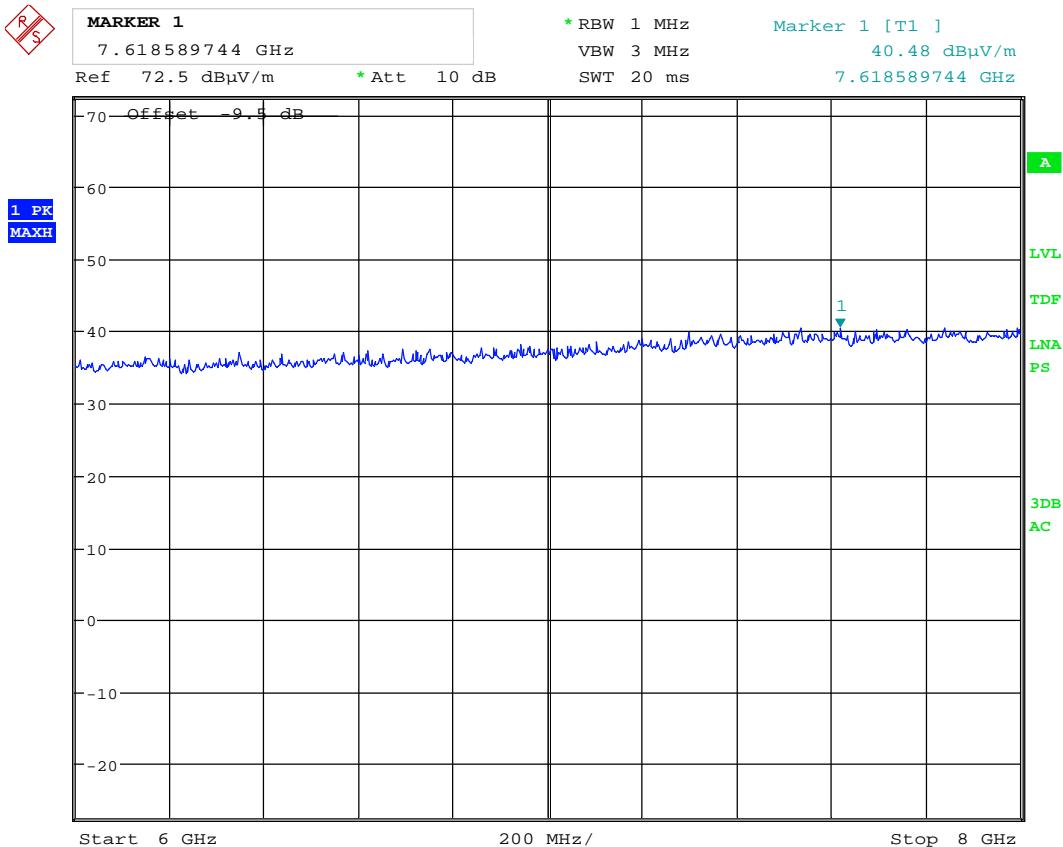
Date: 3.MAR.2016 08:16:53

Radiated Emissions, 3 - 6GHz, 2462MHz, VP, 802.11n, 65Mbps



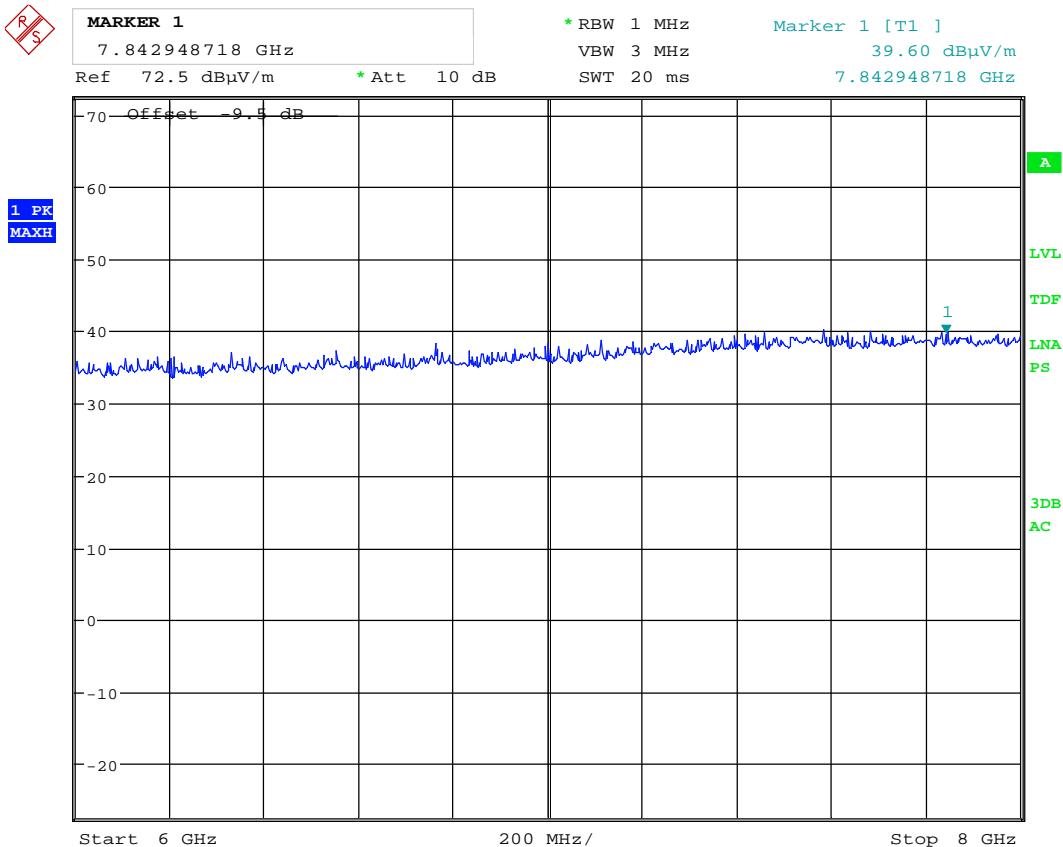
Date: 3.MAR.2016 08:14:06

Radiated Emissions, 3 - 6GHz, 2462MHz, HP, 802.11n, 65Mbps



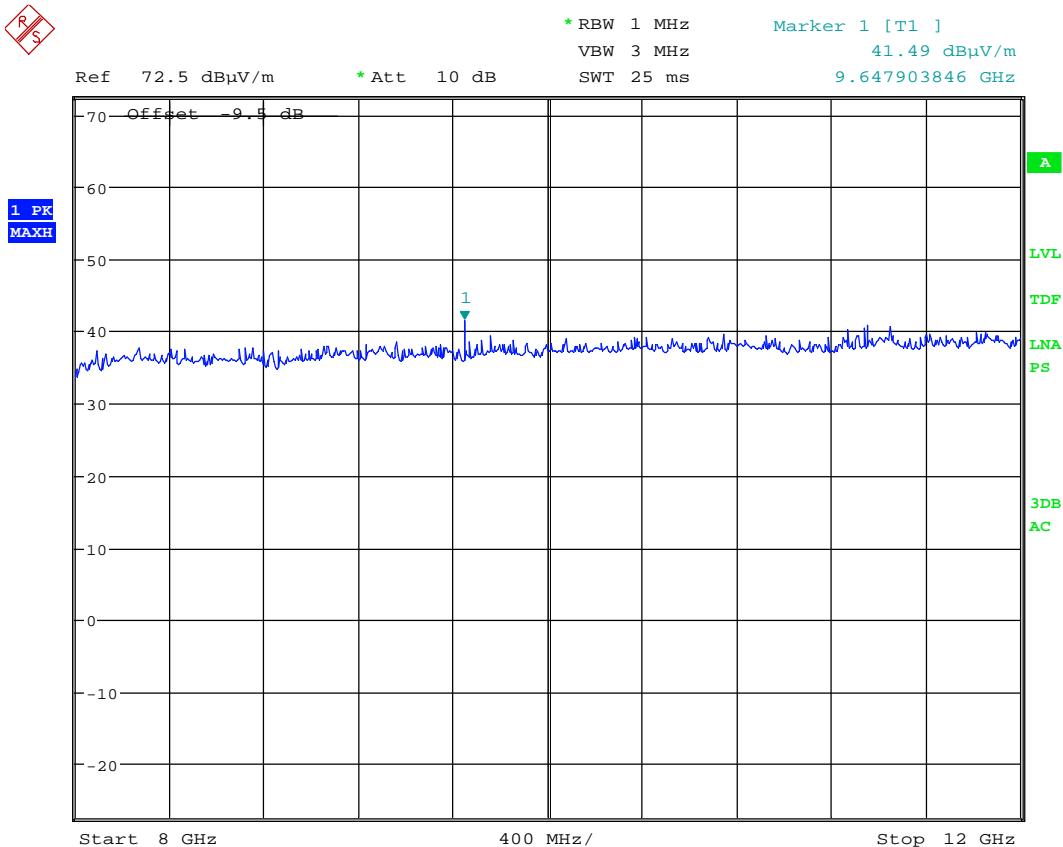
Date: 3.MAR.2016 13:01:13

Radiated Emissions, 6 - 8GHz, VP, 802.11b,g,n @1m



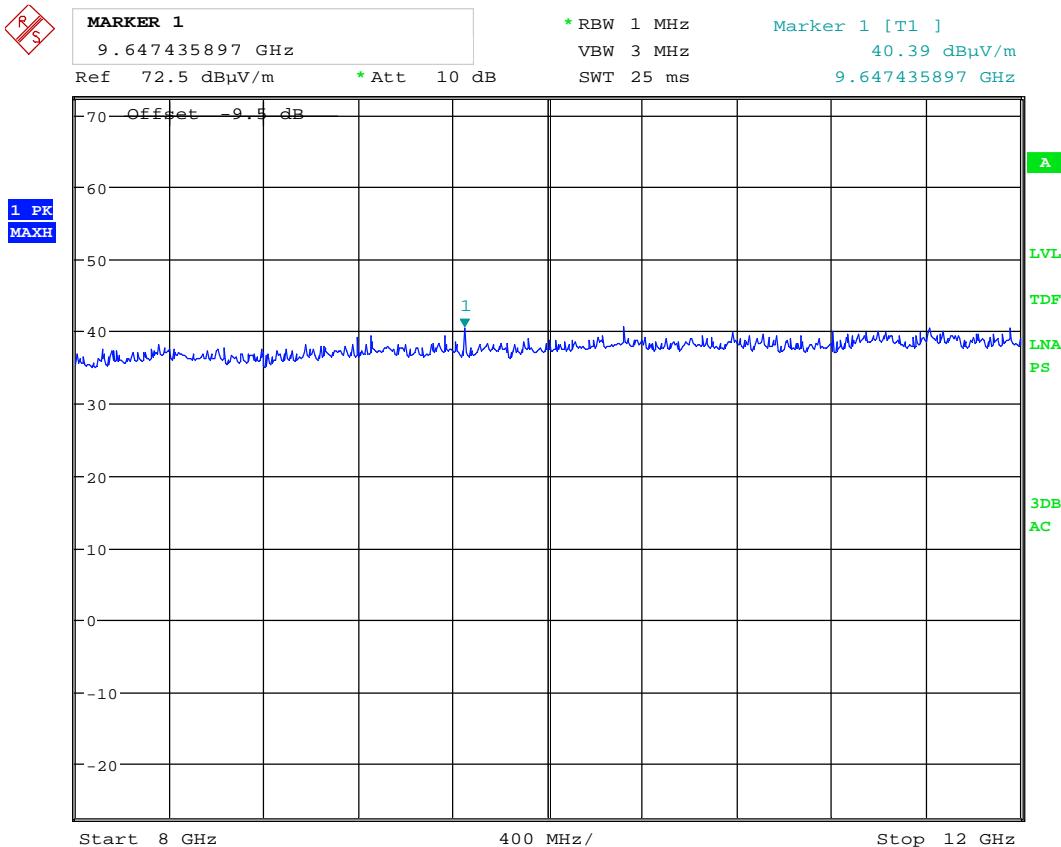
Date: 3.MAR.2016 13:02:33

Radiated Emissions, 6 - 8GHz, HP, 802.11b,g,n @1m



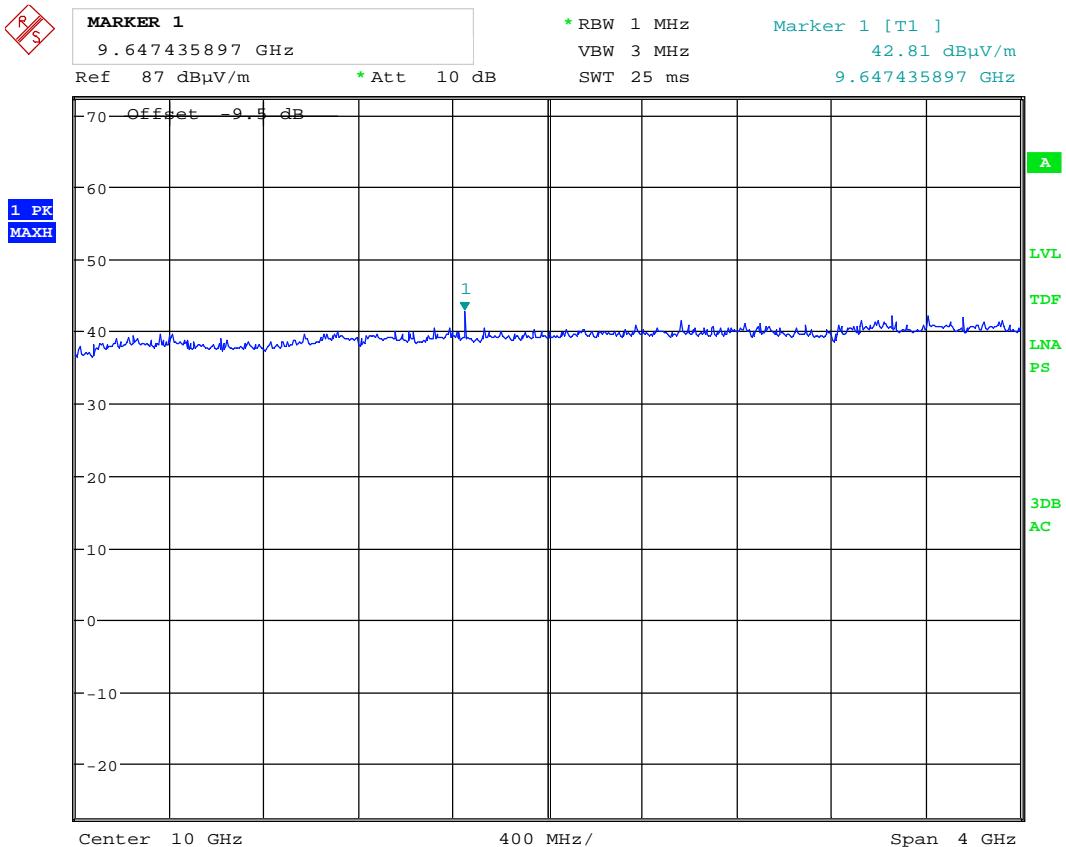
Date: 3.MAR.2016 13:56:45

Radiated Emissions, 8 - 12GHz, VP, 802.11g, 9Mbps @1m



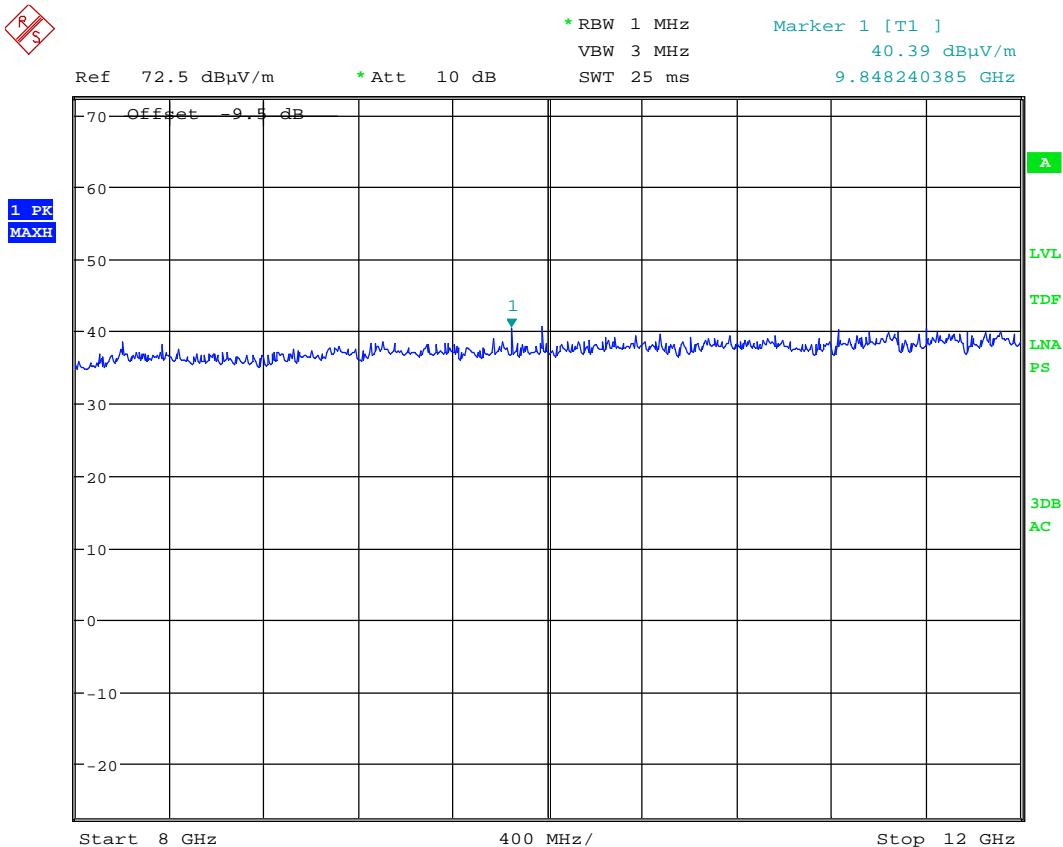
Date: 3.MAR.2016 13:57:12

Radiated Emissions, 8 - 12GHz, HP, 802.11g, 9Mbps @1m



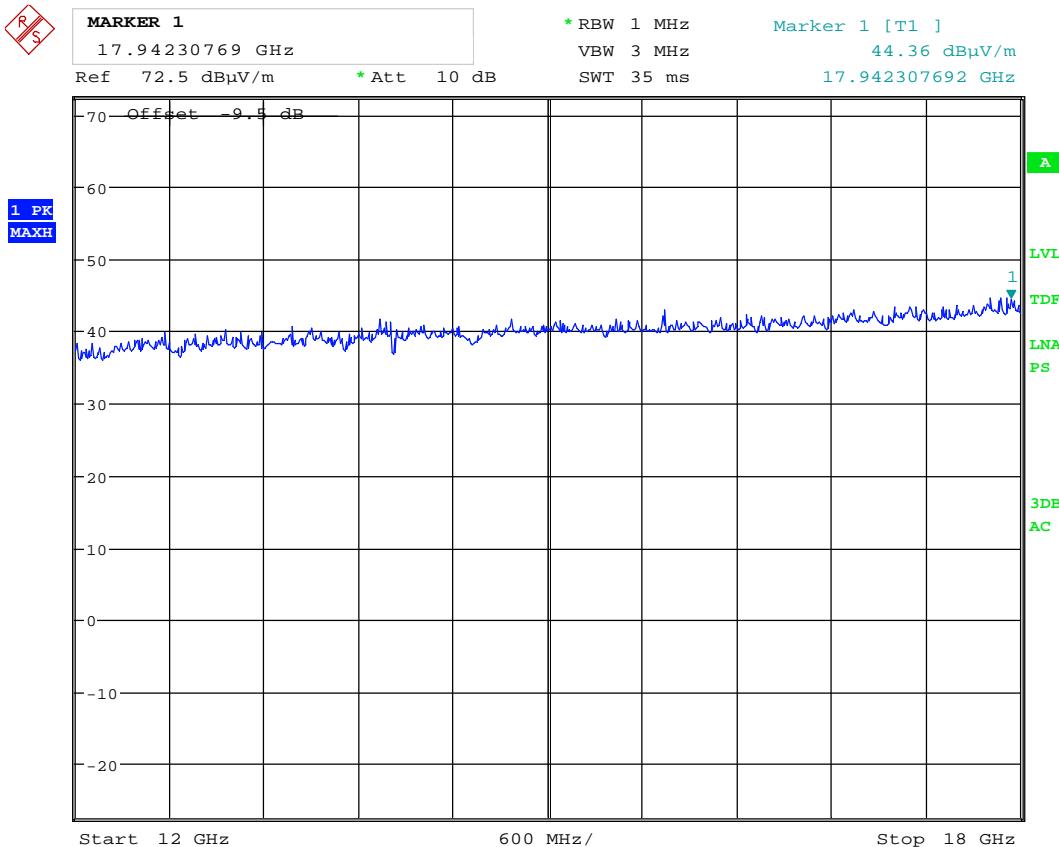
Date: 3.MAR.2016 13:41:28

Radiated Emissions, 8 - 12GHz, VP, 802.11n, 65Mbps @1m



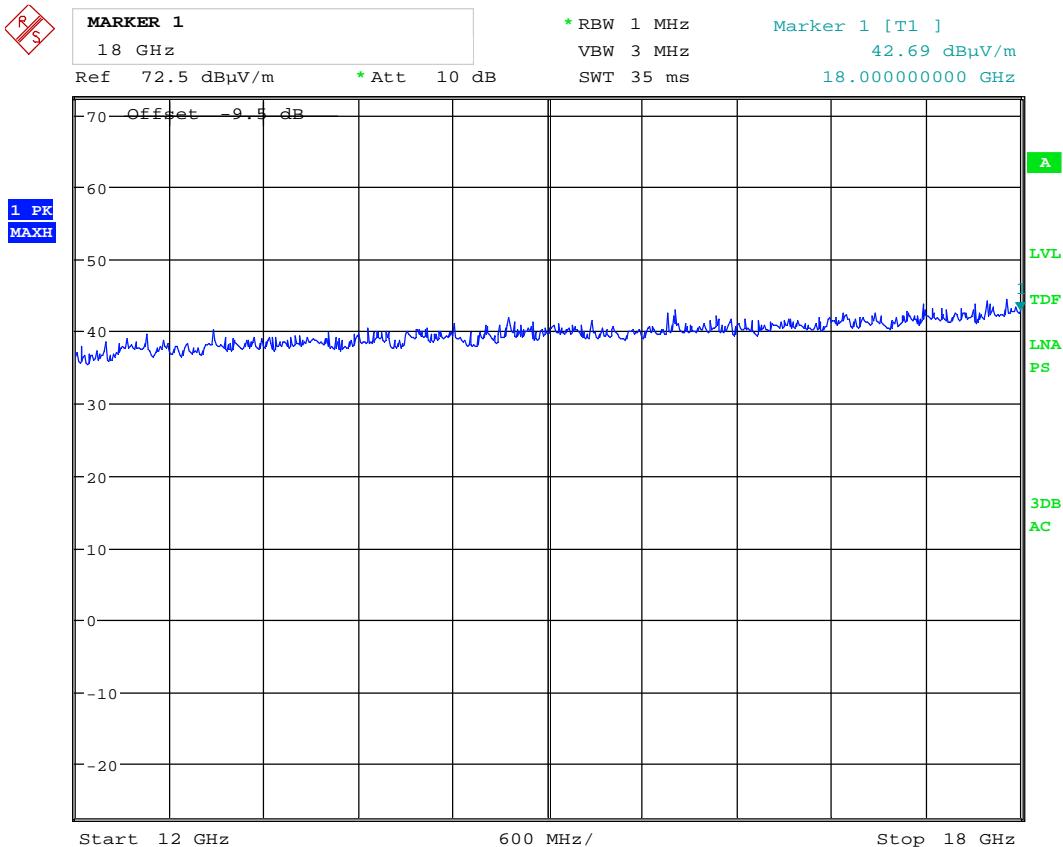
Date: 3.MAR.2016 13:50:28

Radiated Emissions, 8 - 12GHz, HP, 802.11n, 65Mbps @1m



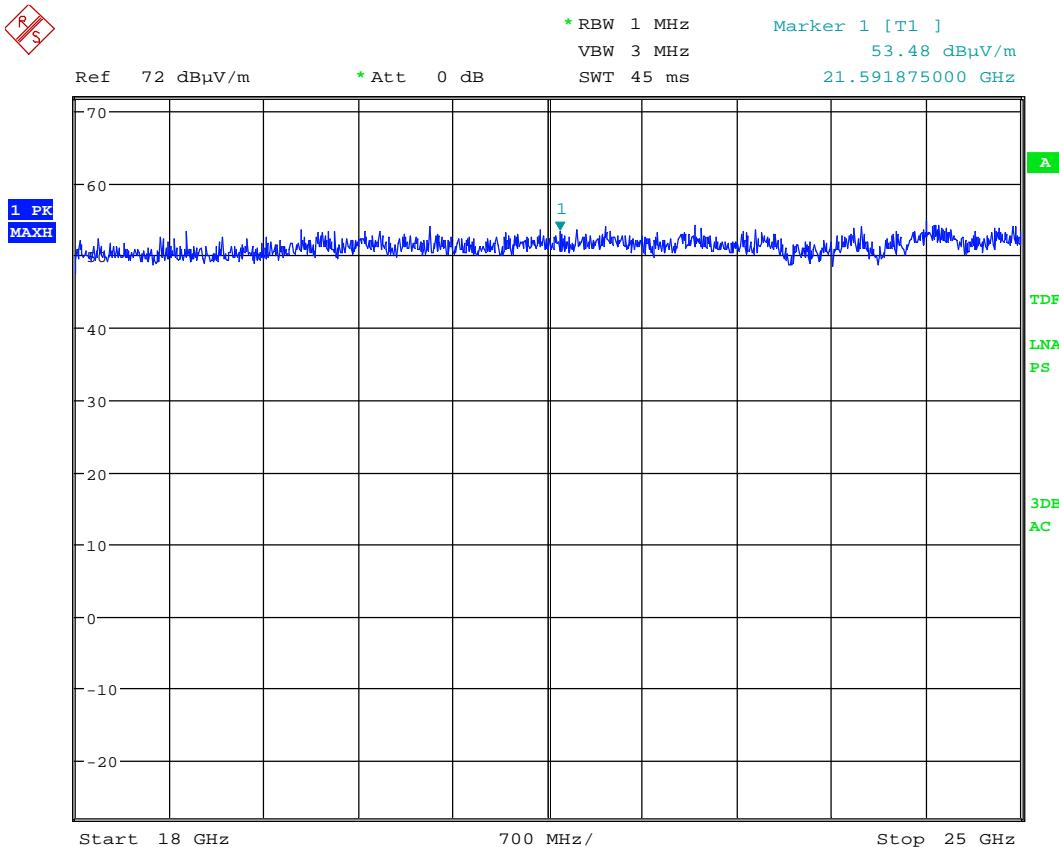
Date: 3.MAR.2016 14:07:44

Radiated Emissions, 12 - 18GHz, VP, 802.11b,g,n



Date: 3.MAR.2016 14:08:12

Radiated Emissions, 12 - 18GHz, HP, 802.11b,g,n



Date: 10.MAR.2016 12:12:11

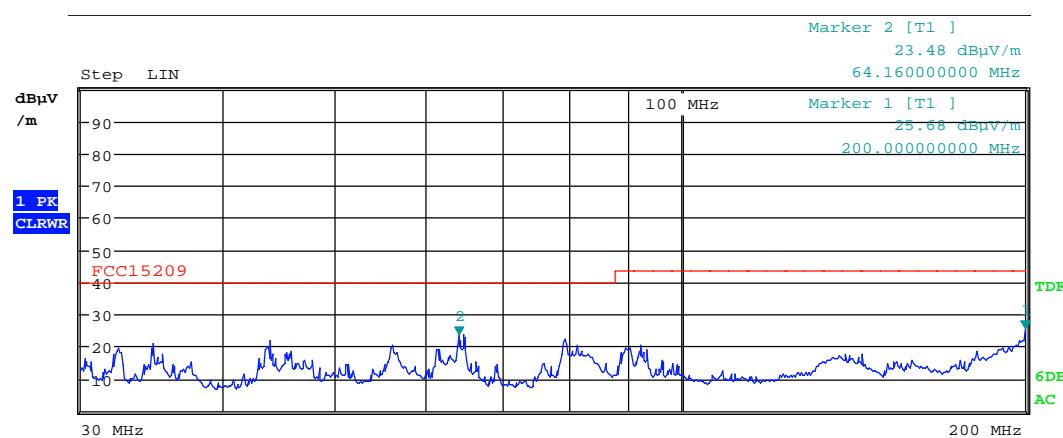
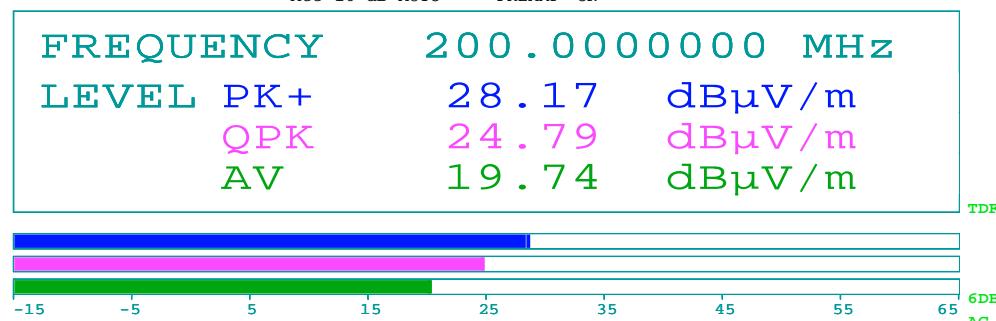
Radiated Emissions, 18 - 25GHz, VP/HP, 802.11b,g,n prescan

RADIATED EMISSIONS WITH RADIO'S ACTIVE

R
S

RBW 120 kHz
MT 1 s
PREAMP ON
Att 10 dB AUTO

TDF



Date: 3.AUG.2016 14:08:19

Radiated emissions HP, 30 – 200MHz

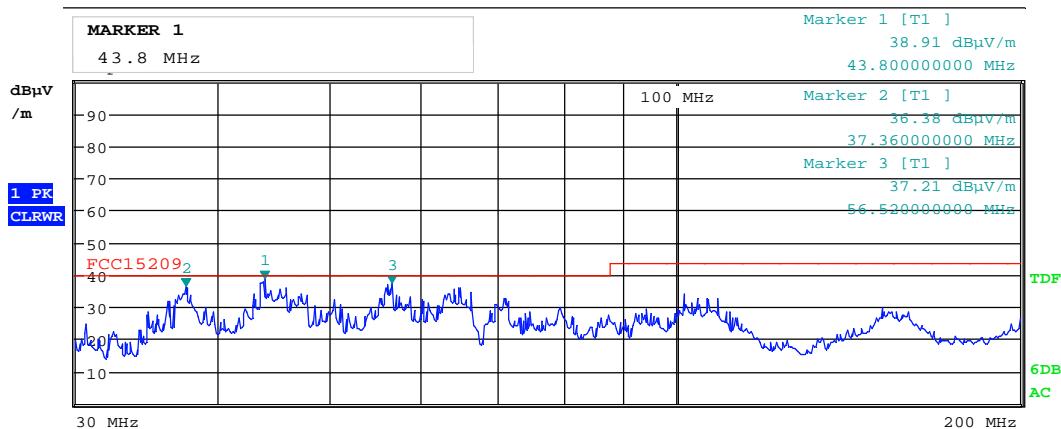
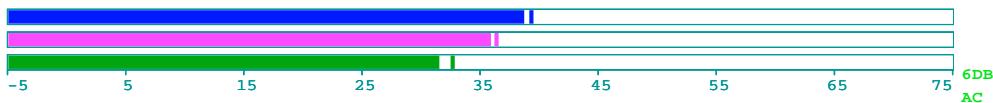
R
S

Att 20 dB AUTO

RBW 120 kHz
MT 100 ms
PREAMP ON

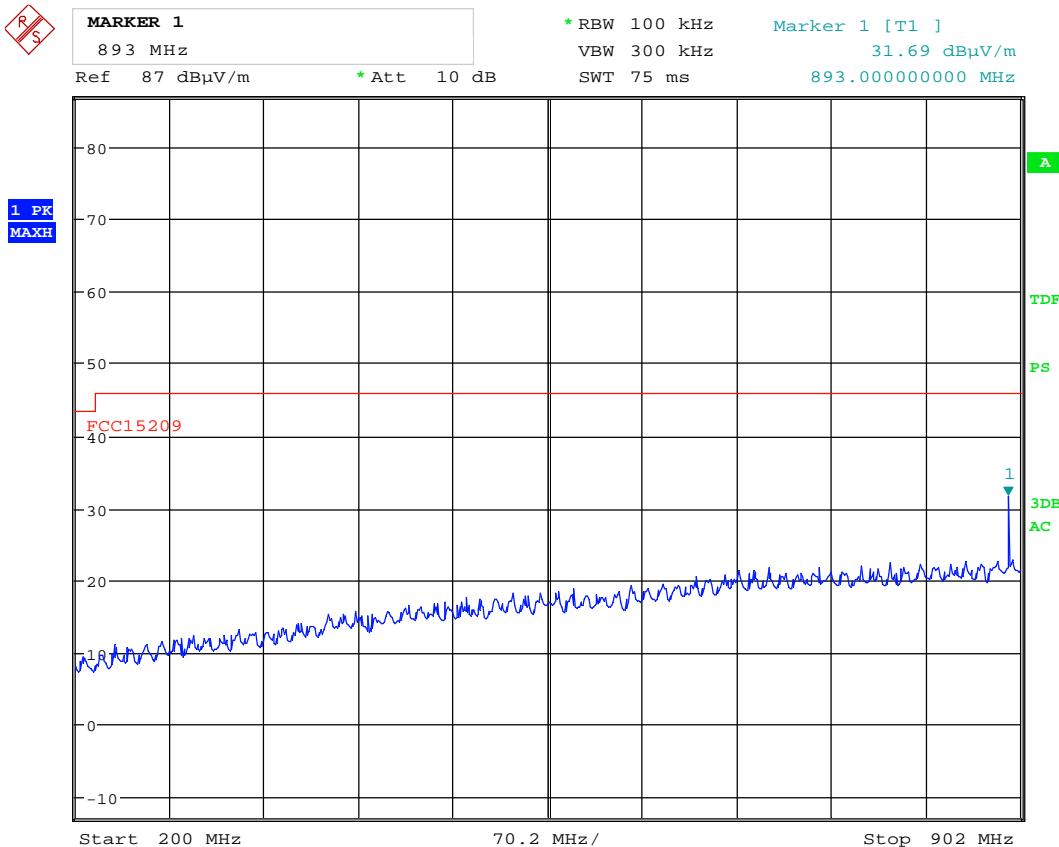
FREQUENCY	43.8000000 MHz
LEVEL PK+	38.99 dBμV/m
QPK	35.86 dBμV/m
AV	28.63 dBμV/m

TDF



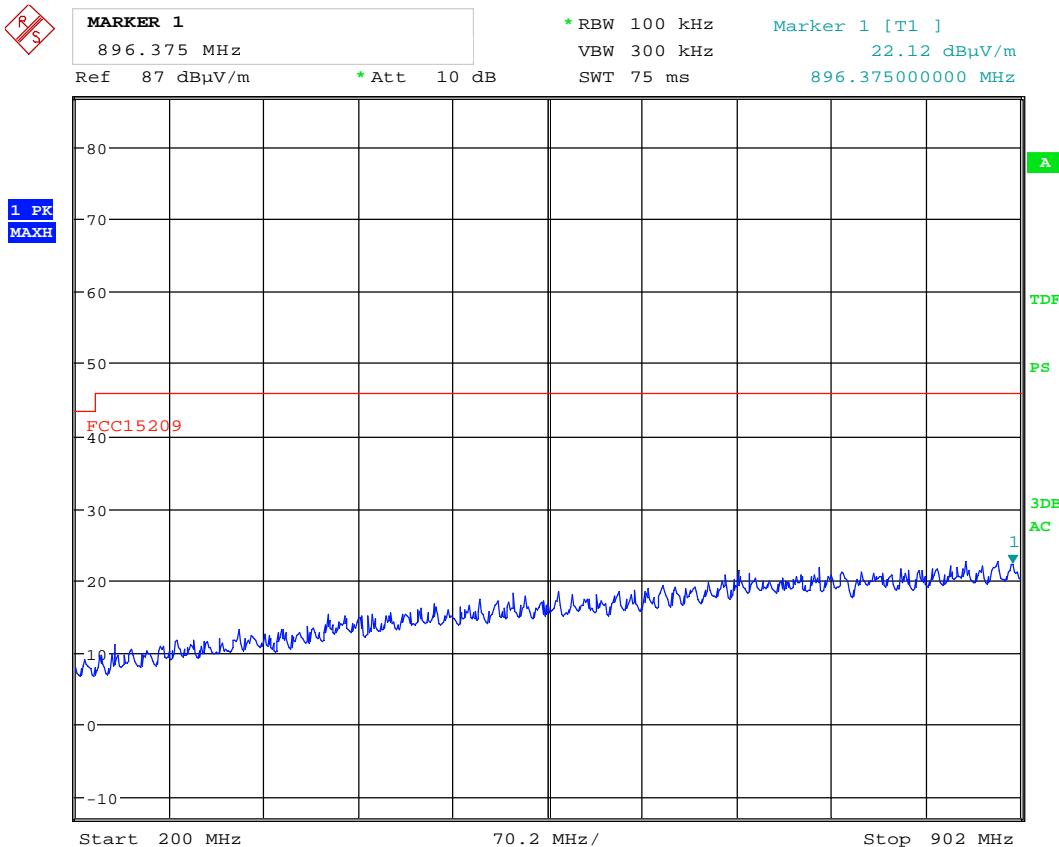
Date: 3.AUG.2016 13:53:43

Radiated emissions VP, 30 – 200MHz



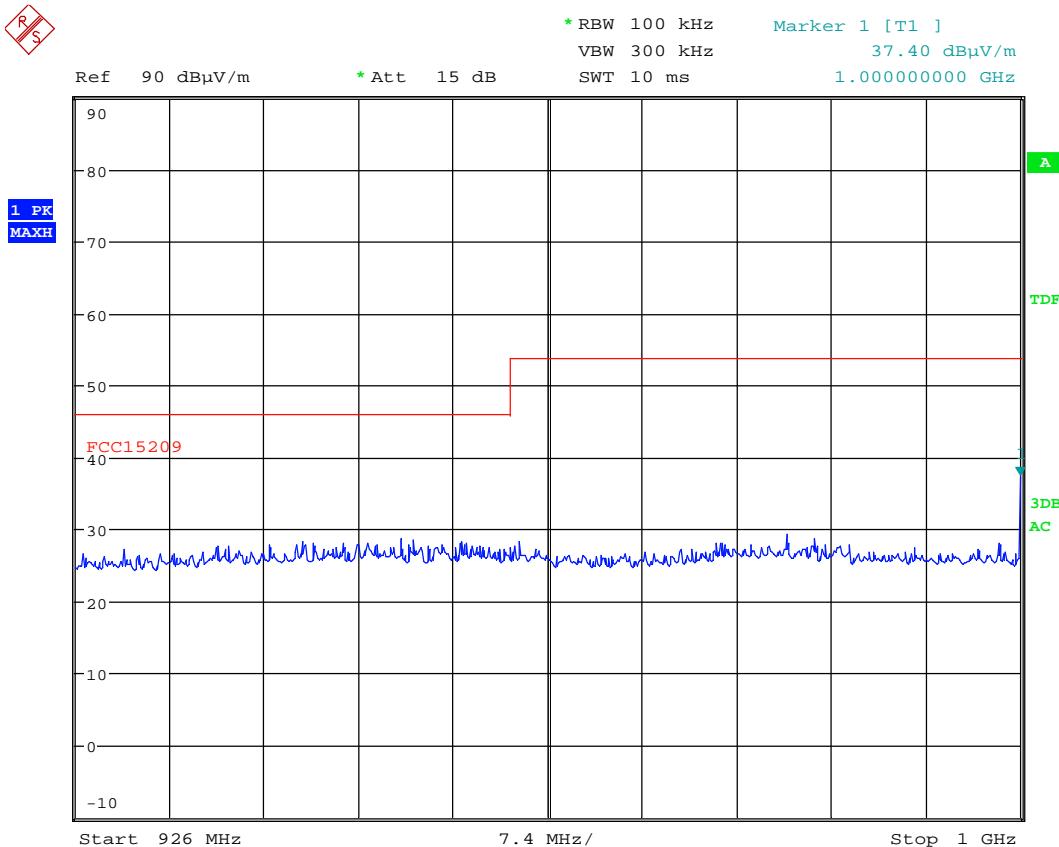
Date: 3.AUG.2016 19:46:45

Radiated emissions HP,200 - 902MHz



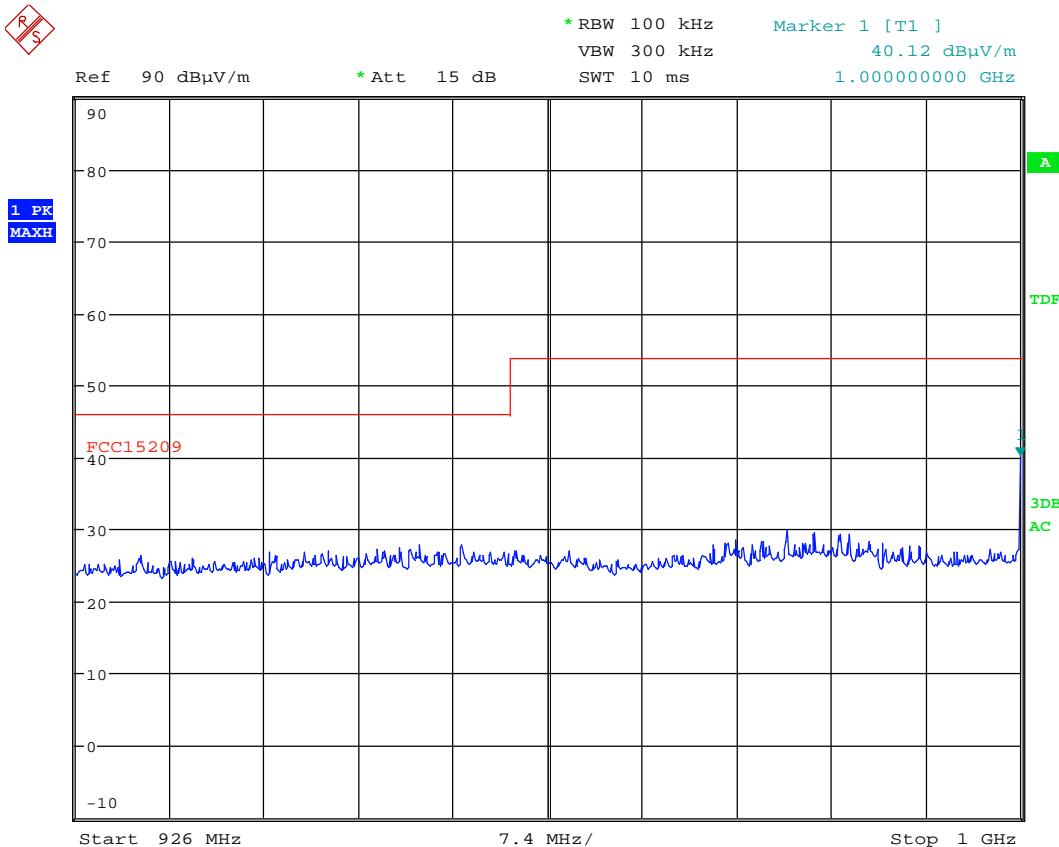
Date: 3.AUG.2016 19:46:12

Radiated emissions VP, 200 - 902MHz



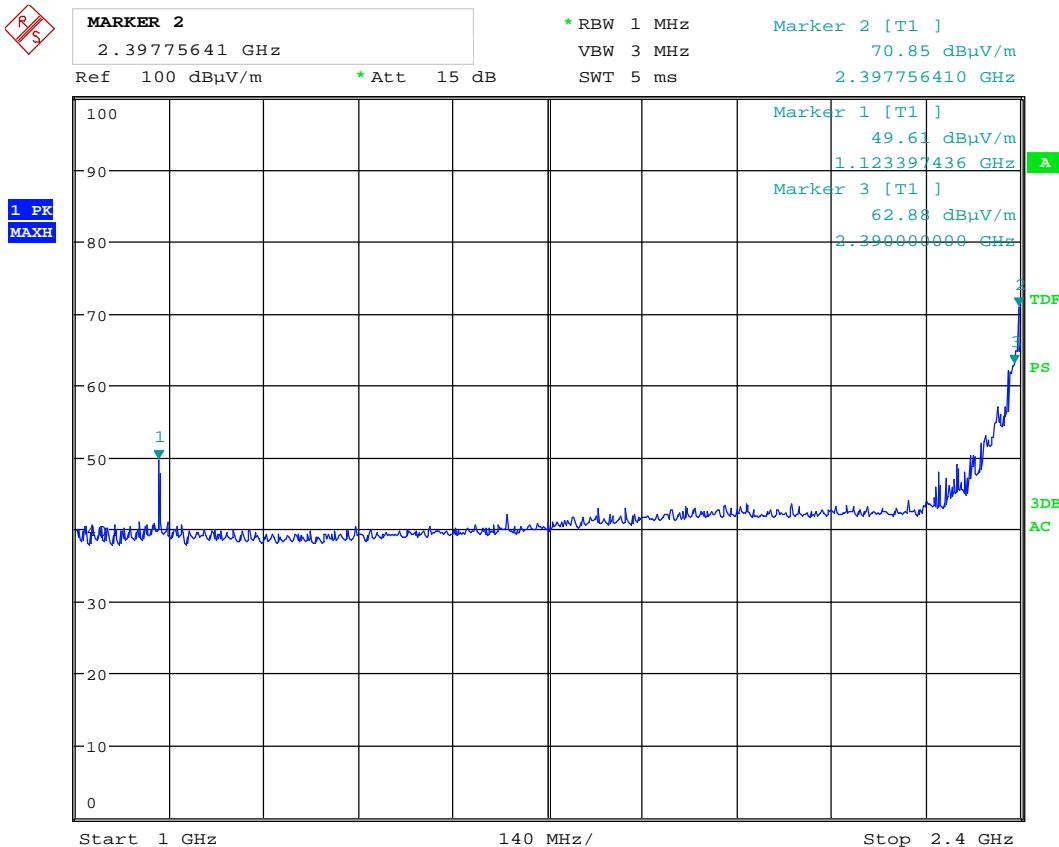
Date: 3.AUG.2016 16:25:11

Radiated emissions HP, 926 - 1000MHz



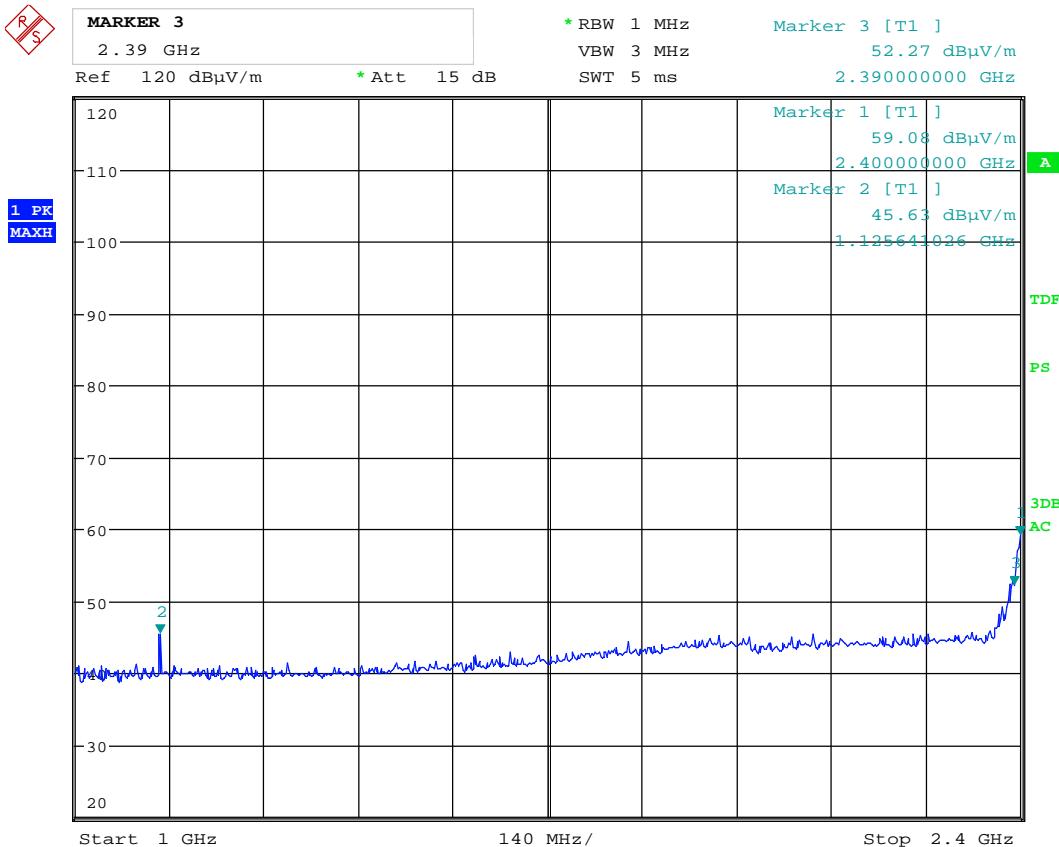
Date: 3.AUG.2016 16:27:22

Radiated emissions VP, 926 - 1000MHz



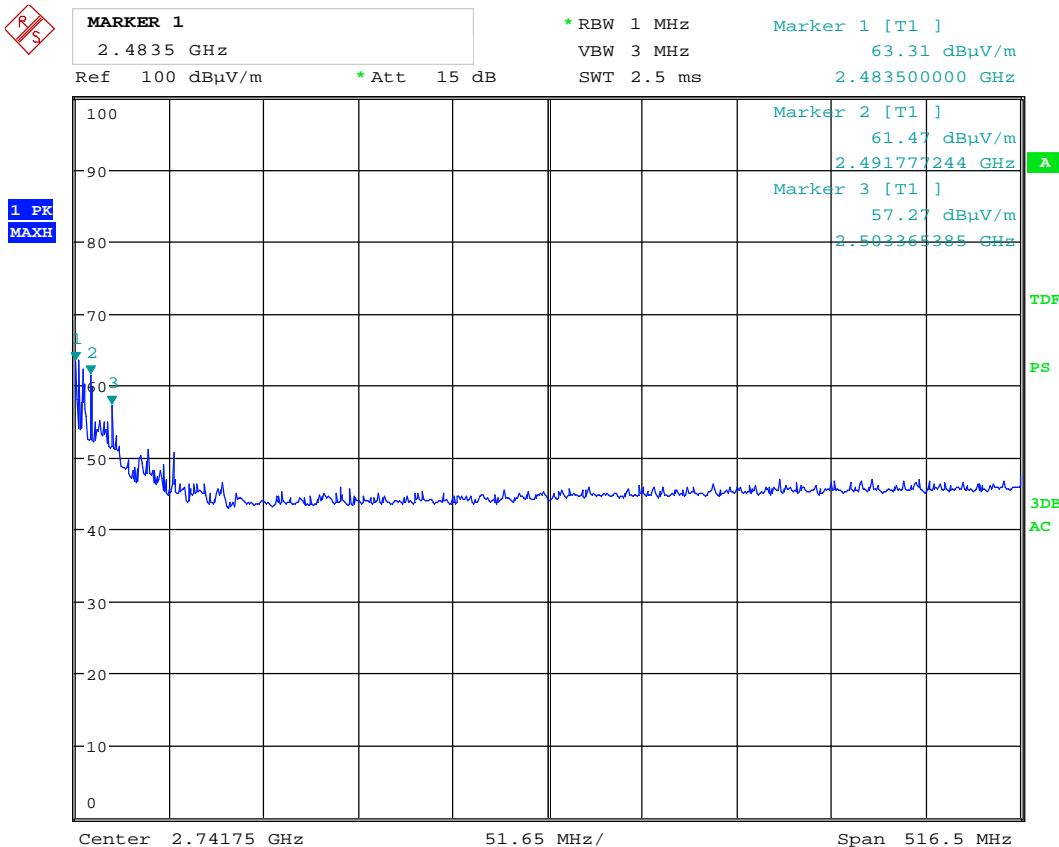
Date: 3.AUG.2016 17:42:46

Radiated emissions HP, 1 - 2.4GHz, PK scan



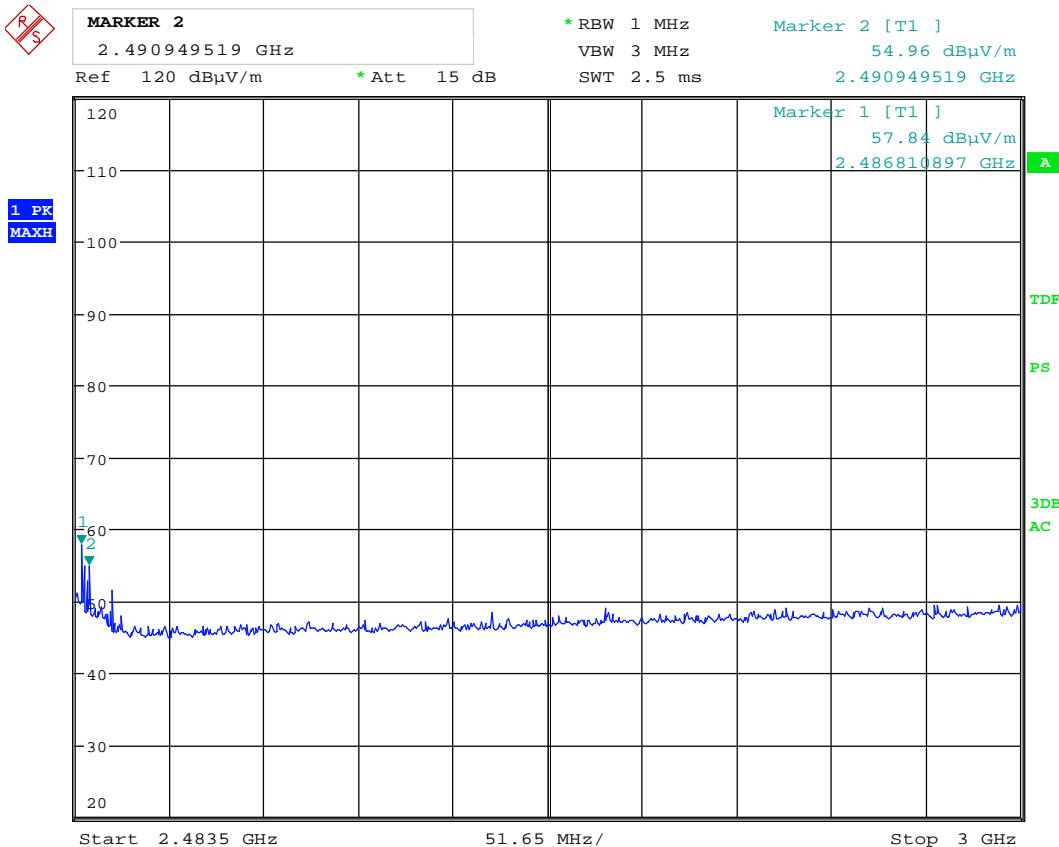
Date: 3.AUG.2016 17:26:13

Radiated emissions VP, 1 - 2.4GHz, PK scan



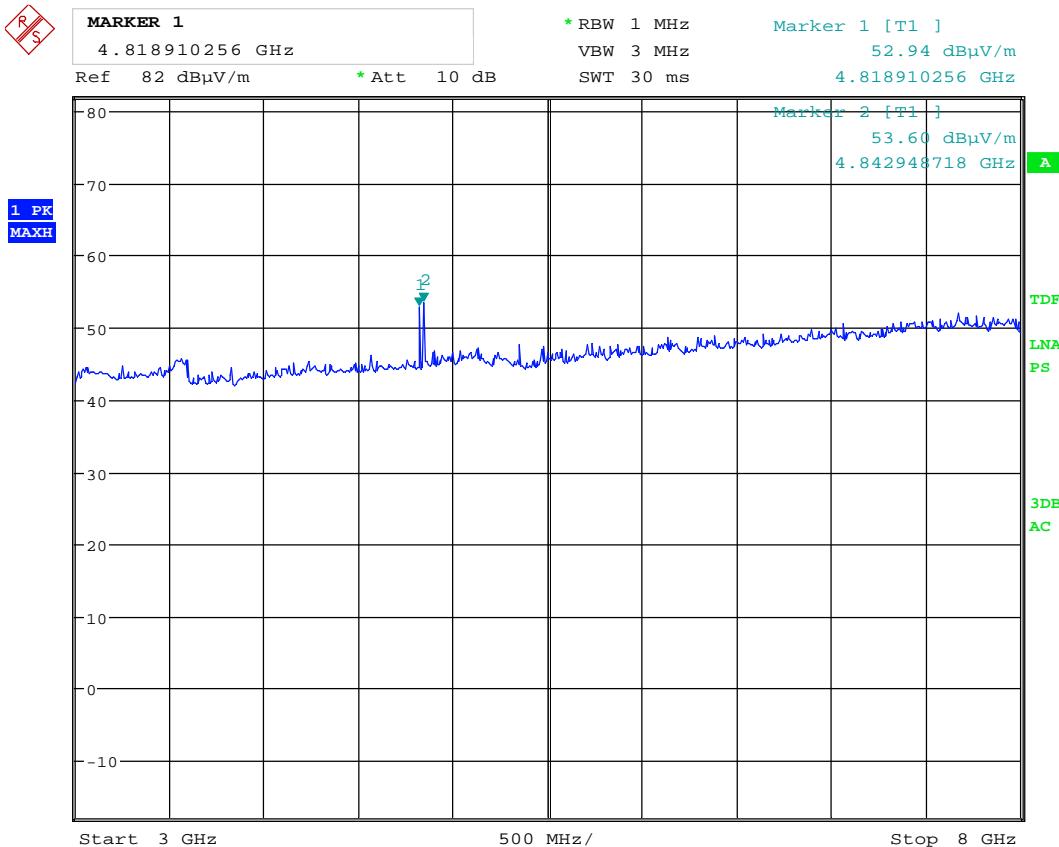
Date: 3.AUG.2016 17:47:40

Radiated emissions HP, 2.4835 - 3GHz, PK scan



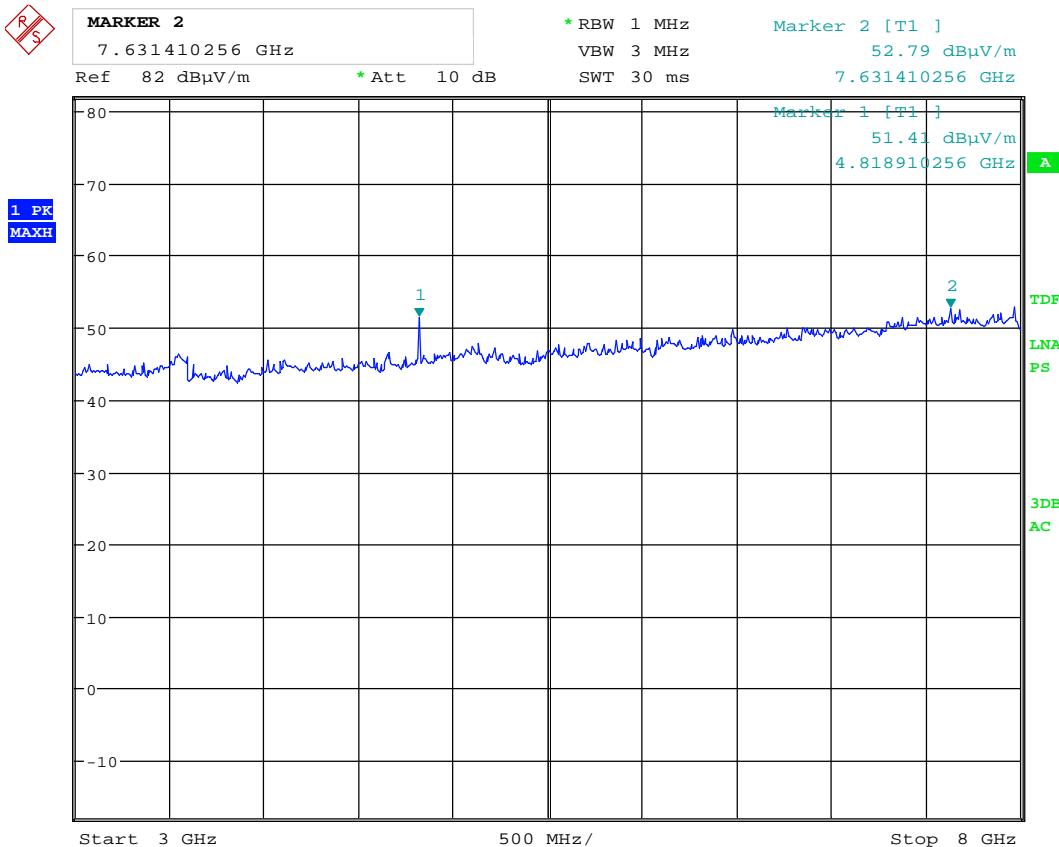
Date: 3.AUG.2016 17:28:11

Radiated emissions VP, 2.4835 - 3GHz, PK scan



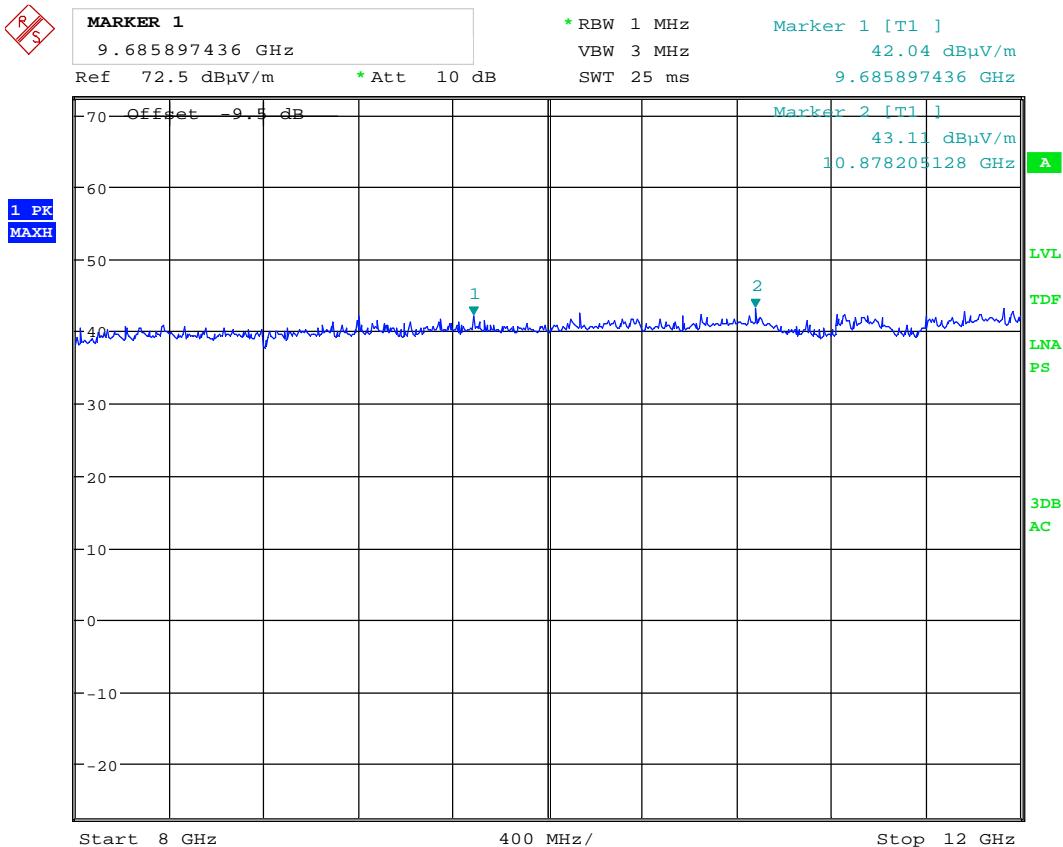
Date: 3.AUG.2016 17:37:19

Radiated emissions HP, 3 - 8GHz, PK scan



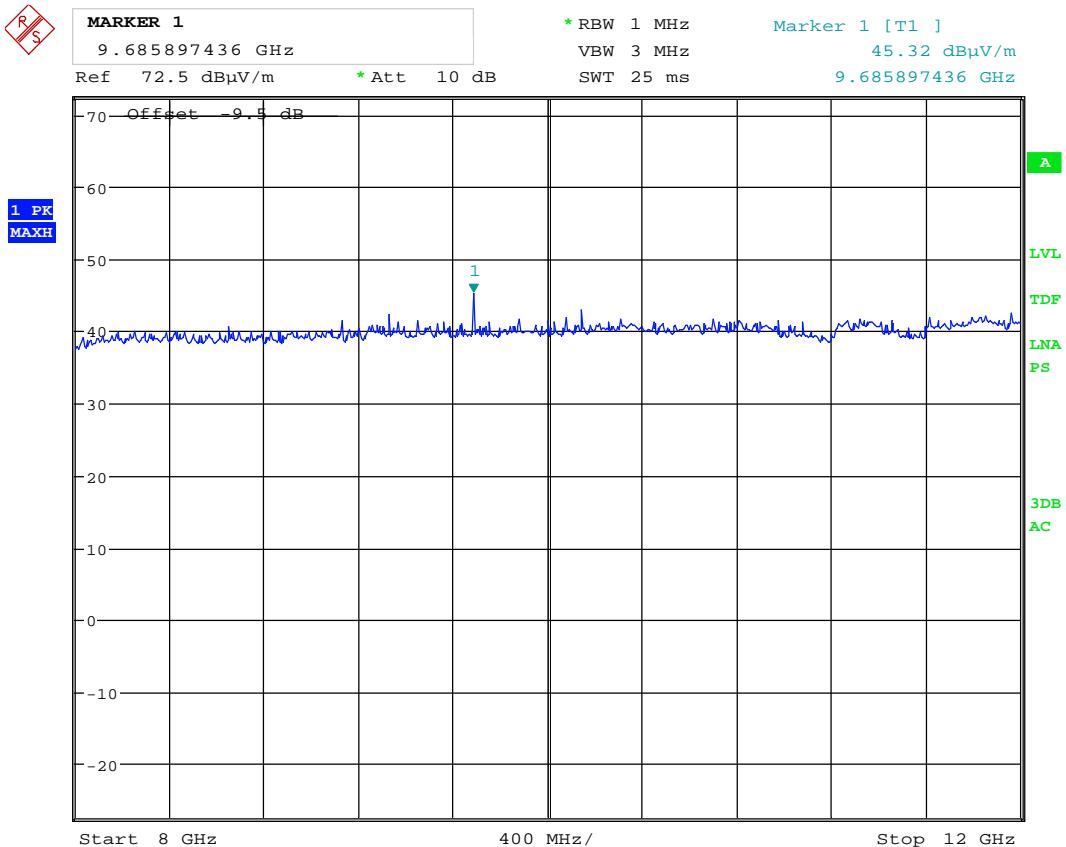
Date: 3.AUG.2016 17:35:58

Radiated emissions VP, 3 - 8GHz, PK scan



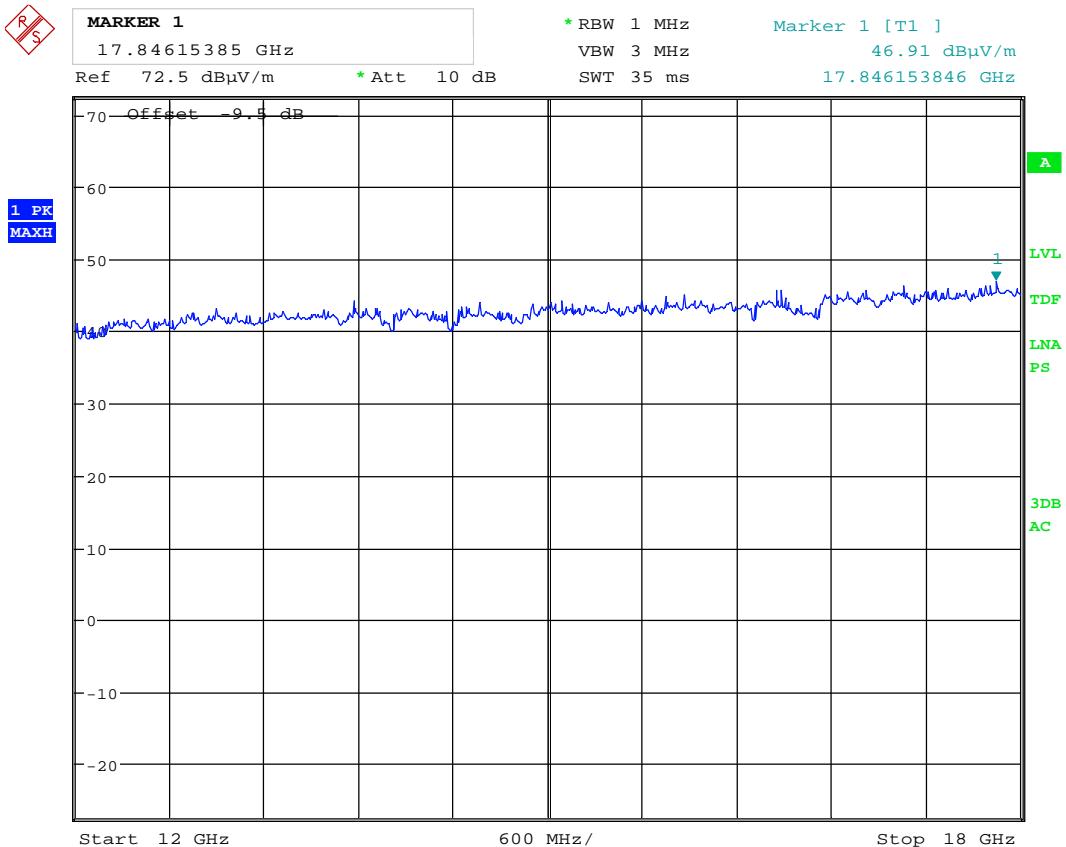
Date: 3.AUG.2016 17:58:20

Radiated emissions HP, 8 - 12GHz, PK scan at 1 m distance (distance correction is included in the plot)



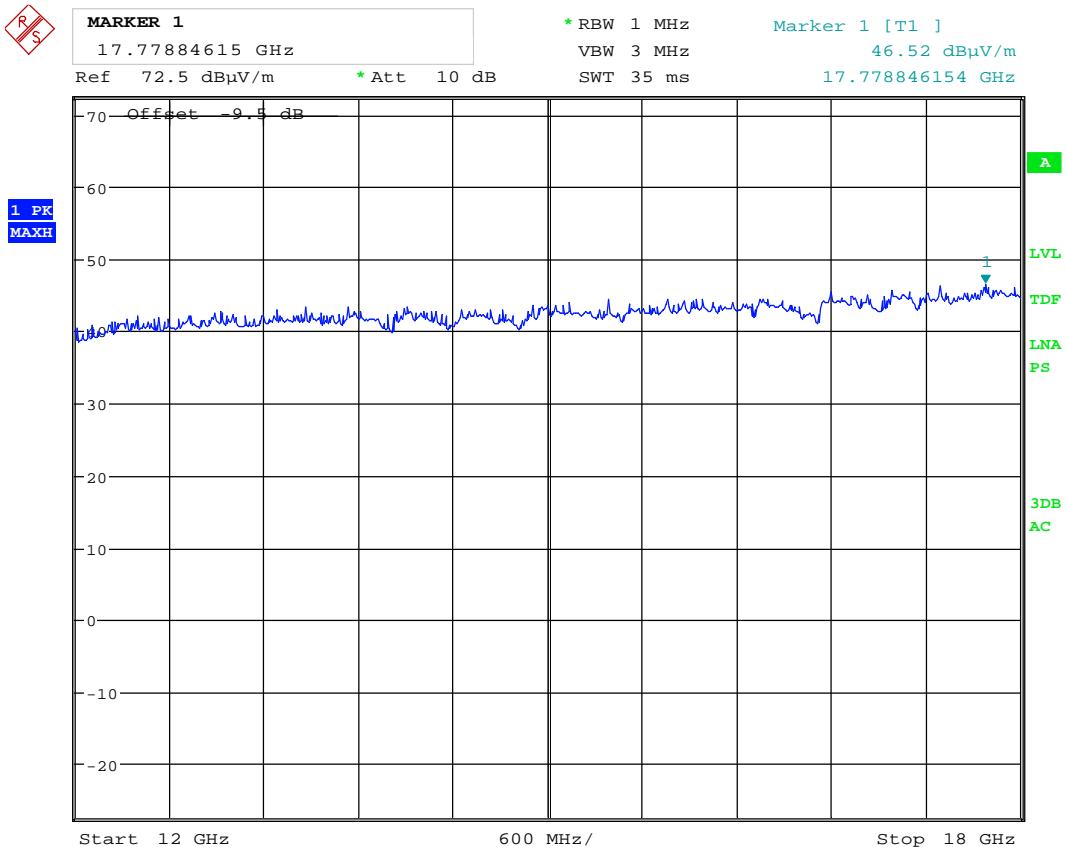
Date: 3.AUG.2016 17:56:38

Radiated emissions VP, 8 - 12GHz, PK scan at 1 m distance (distance correction is included in the plot)



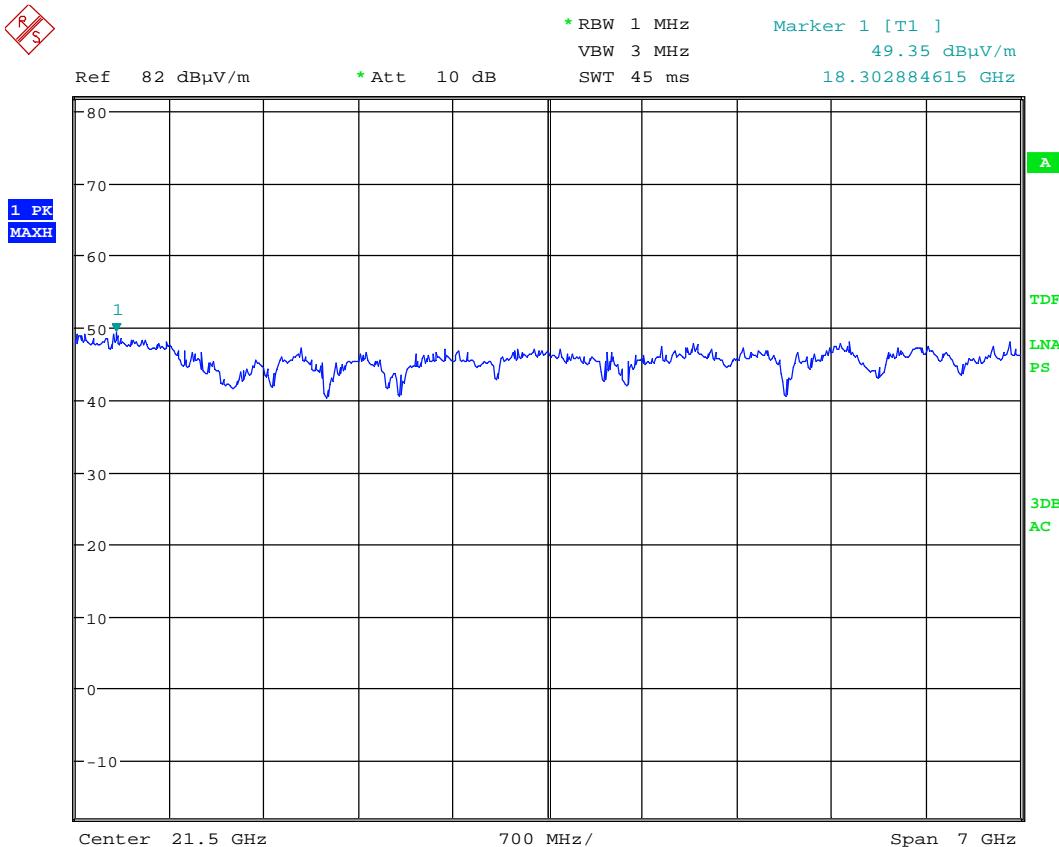
Date: 3.AUG.2016 18:01:41

Radiated emissions HP, 12 - 18GHz, PK scan at 1 m distance (distance correction is included in the plot)



Date: 3.AUG.2016 18:02:37

Radiated emissions VP, 12 - 18GHz, PK scan at 1 m distance (distance correction is included in the plot)



Date: 3.AUG.2016 18:04:27

Radiated emissions HP/VP, 8 - 12GHz, PK scan.

3.6 Power Spectral Density (PSD)

Para. No.: 15.247 (d)

Test Performed By: G.Suhanthakumar	Date of Test: 2016.02.22
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Test Results: Passed

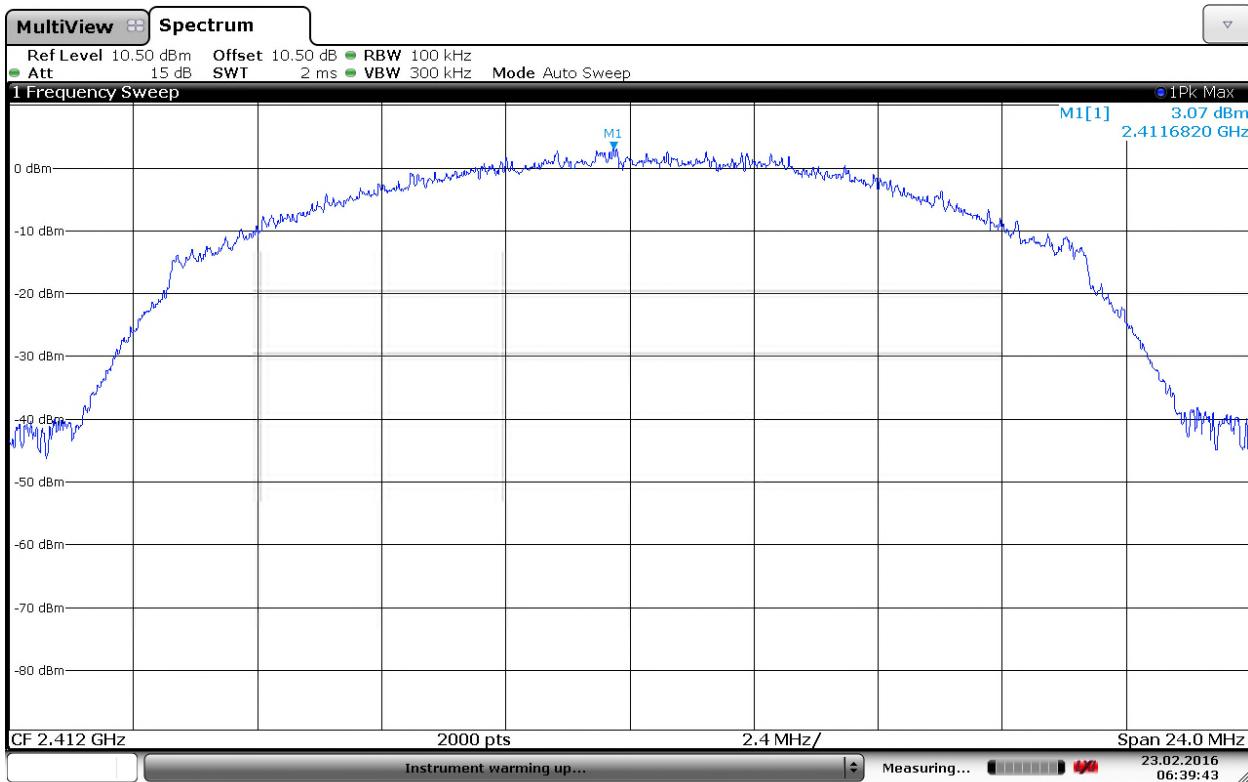
Measured and Calculated Data:

Carrier Frequency (MHz)	Power Spectral Density (dBm)		
	802.11b, 5.5 Mbps	802.11g, 9 Mbps	802.11n, 65Mbps
2412	-12.13	-20.19	-22.84
2437	-12.94	-20.17	-22.03
2462	-13.08	-19.76	-21.74

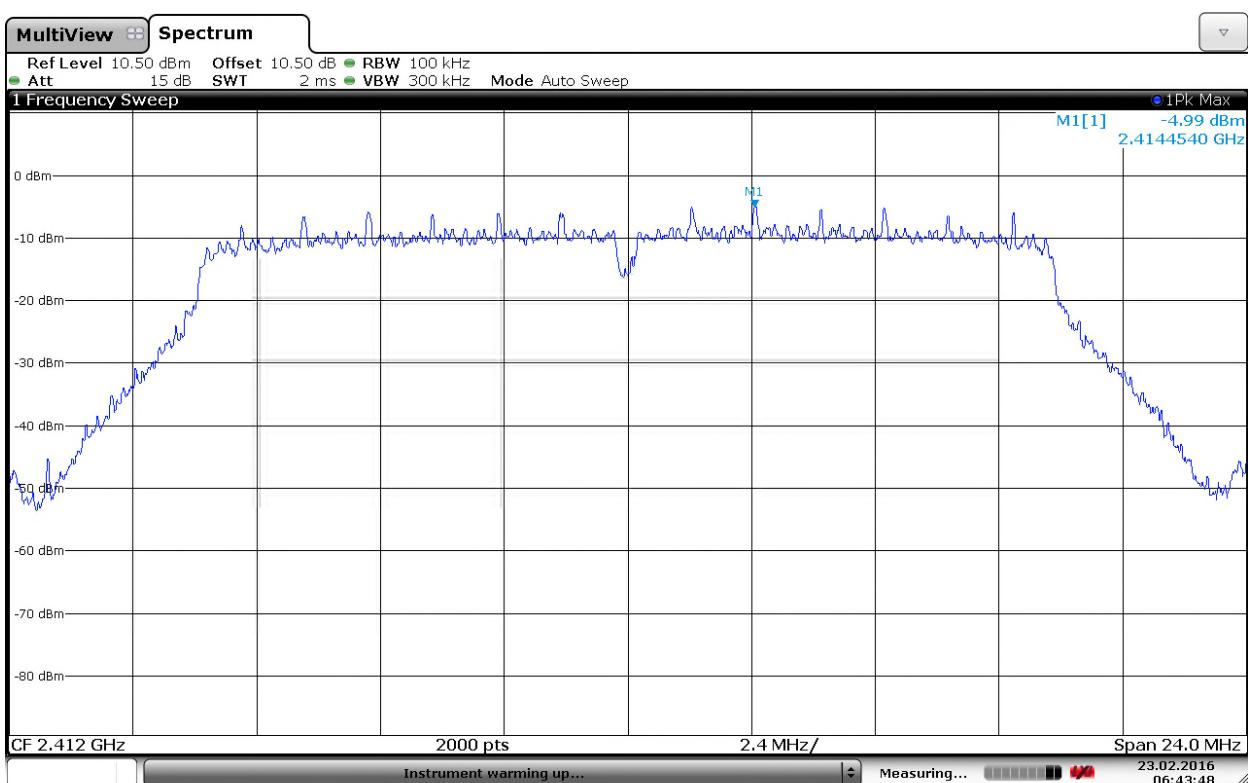
The measured values with 100kHz RBW are corrected by a Bandwidth Correction Factor of -15.2 dB.

Requirements:

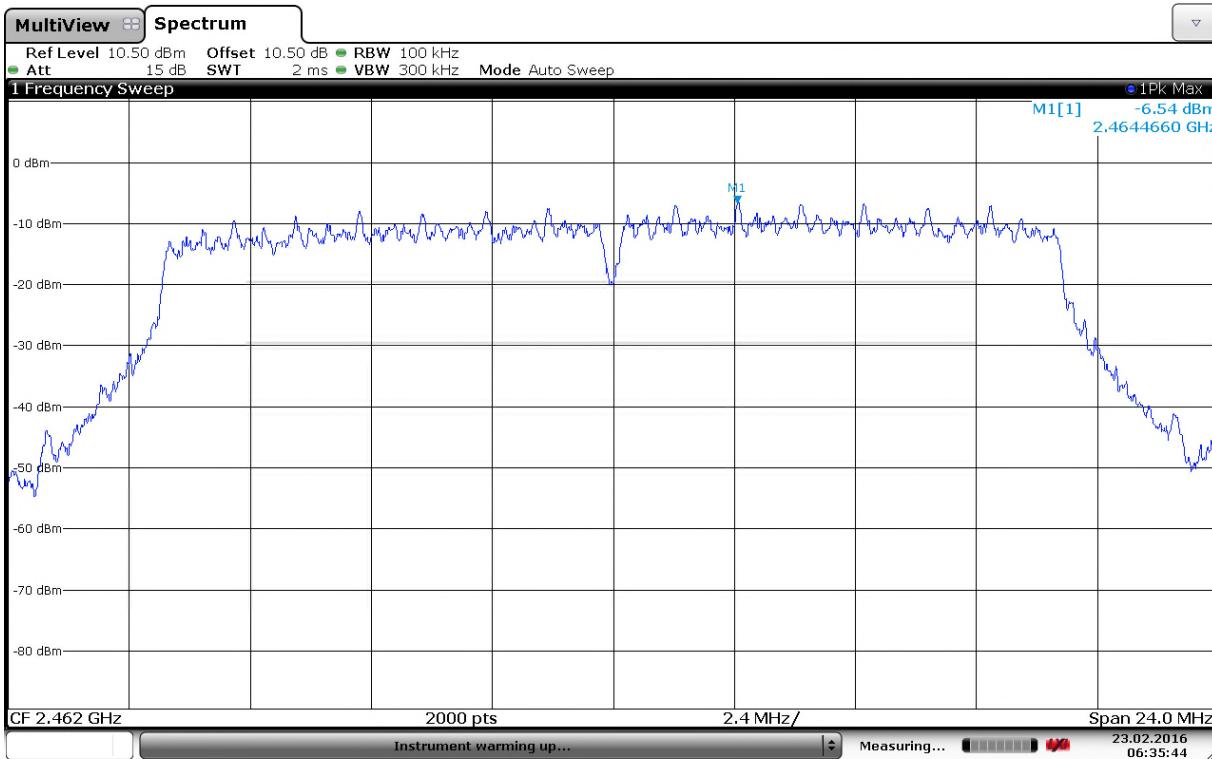
The Power Spectral Density of a Digital Transmission System shall be no greater than +8 dBm in any 3 kHz band



PSD, 2412 MHz, 802.11b, 5.5 Mbps

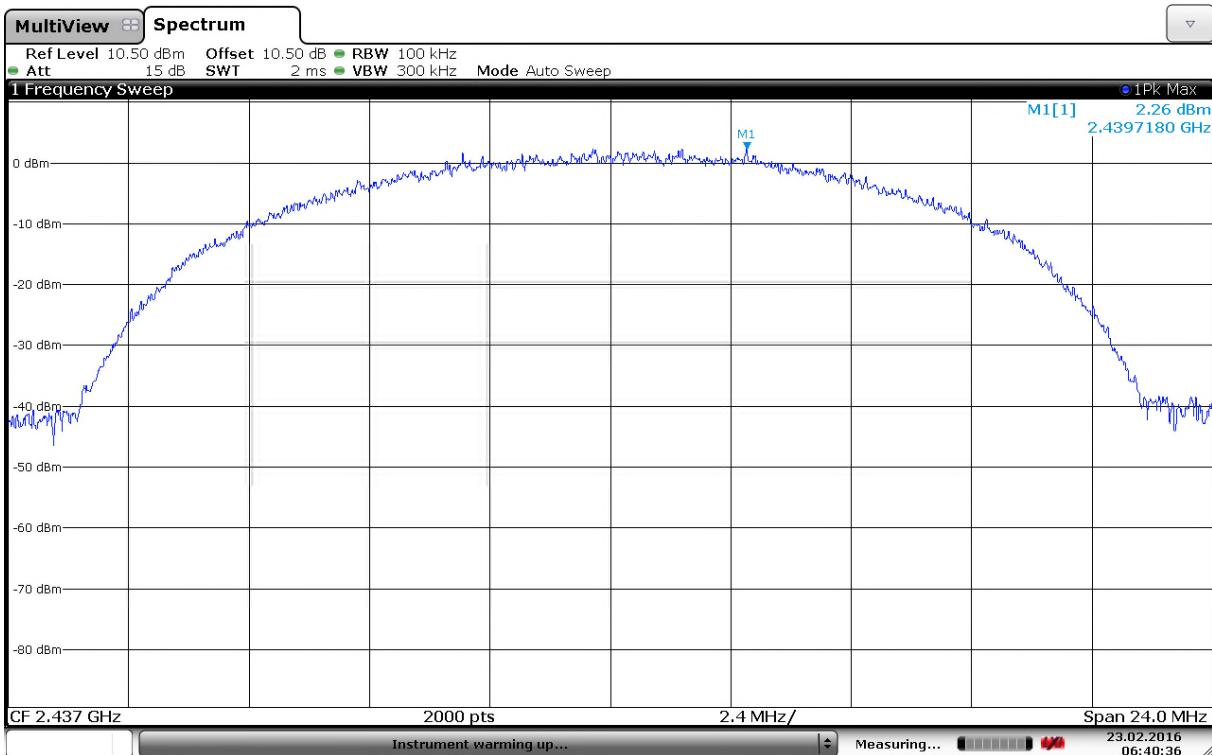


PSD, 2412 MHz, 802.11g, 9 Mbps



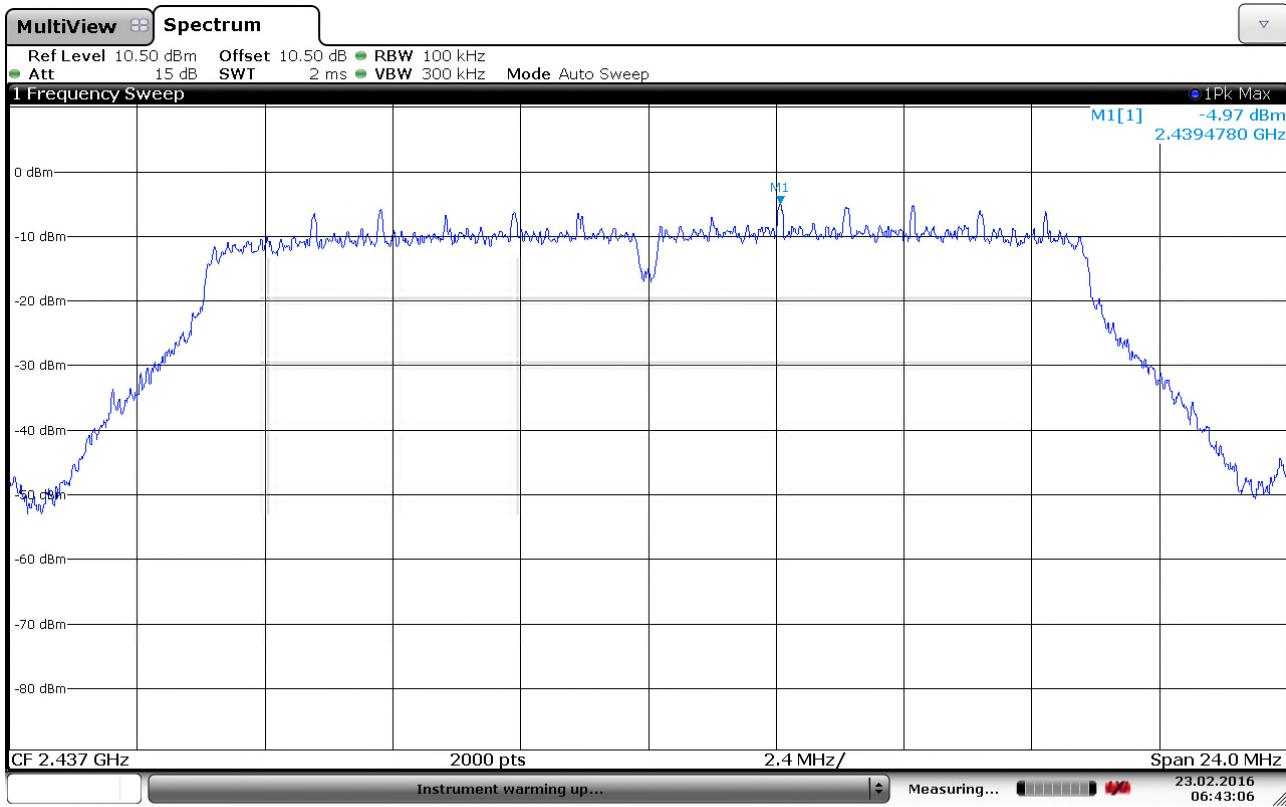
Date: 23.FEB.2016 06:35:44

PSD, 2412 MHz, 802.11n, 65Mbps



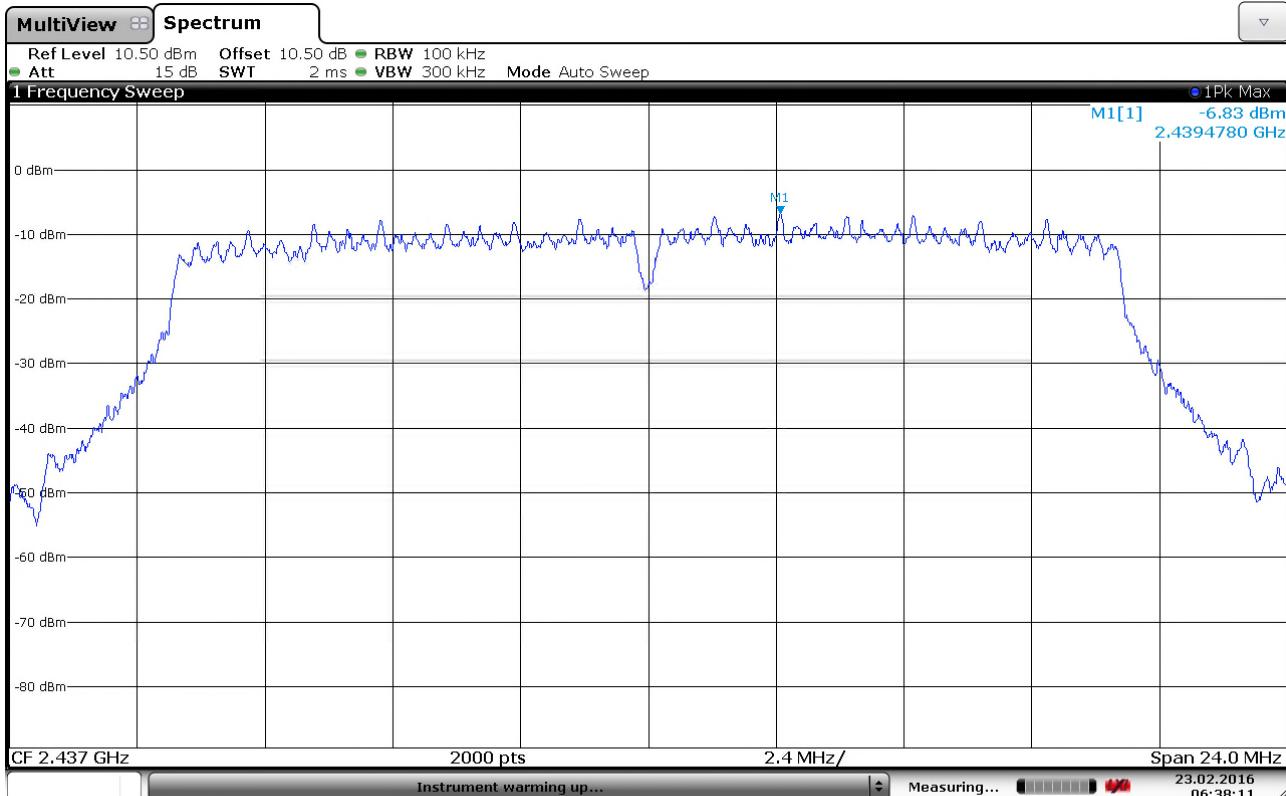
Date: 23.FEB.2016 06:40:36

PSD, 2437 MHz, 802.11b, 5.5 Mbps



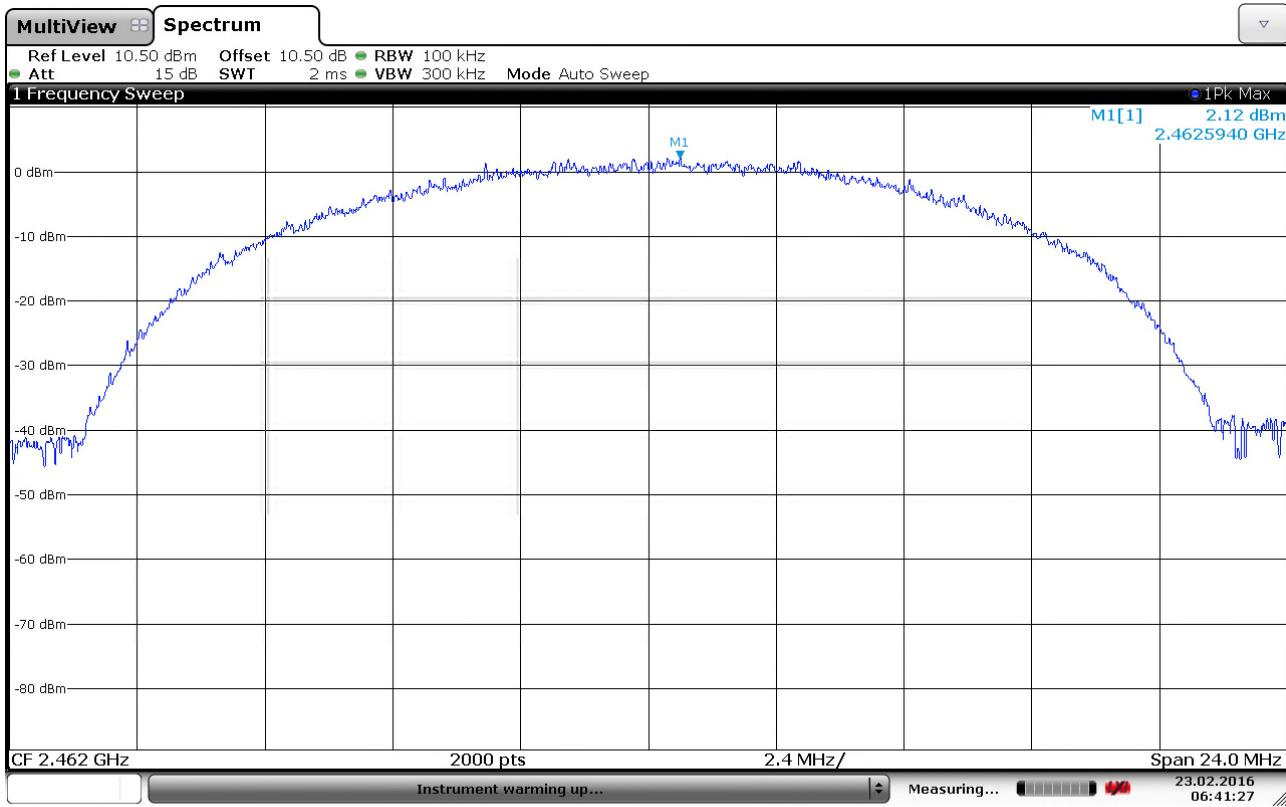
Date: 23.FEB.2016 06:43:06

PSD, 2437 MHz, 802.11g, 9 Mbps



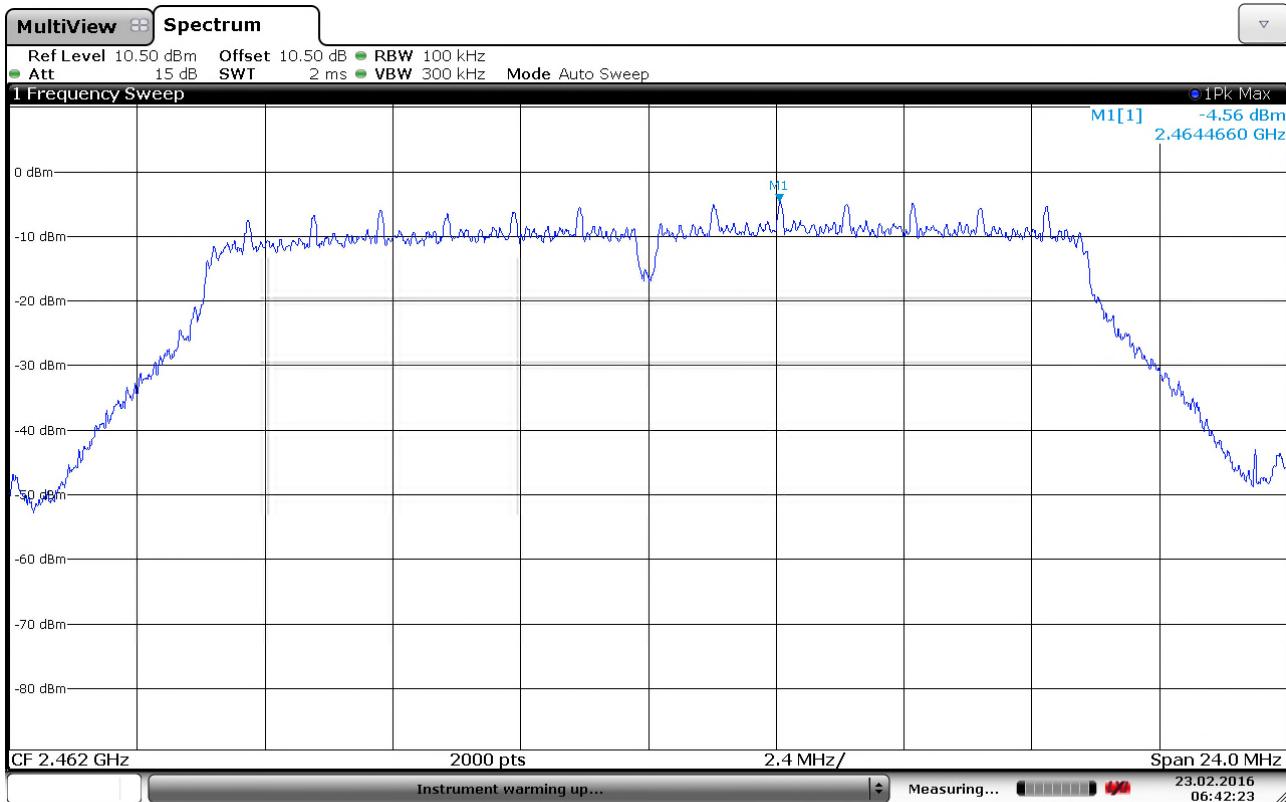
Date: 23.FEB.2016 06:38:10

PSD, 2437 MHz, 802.11n, 65 Mbps



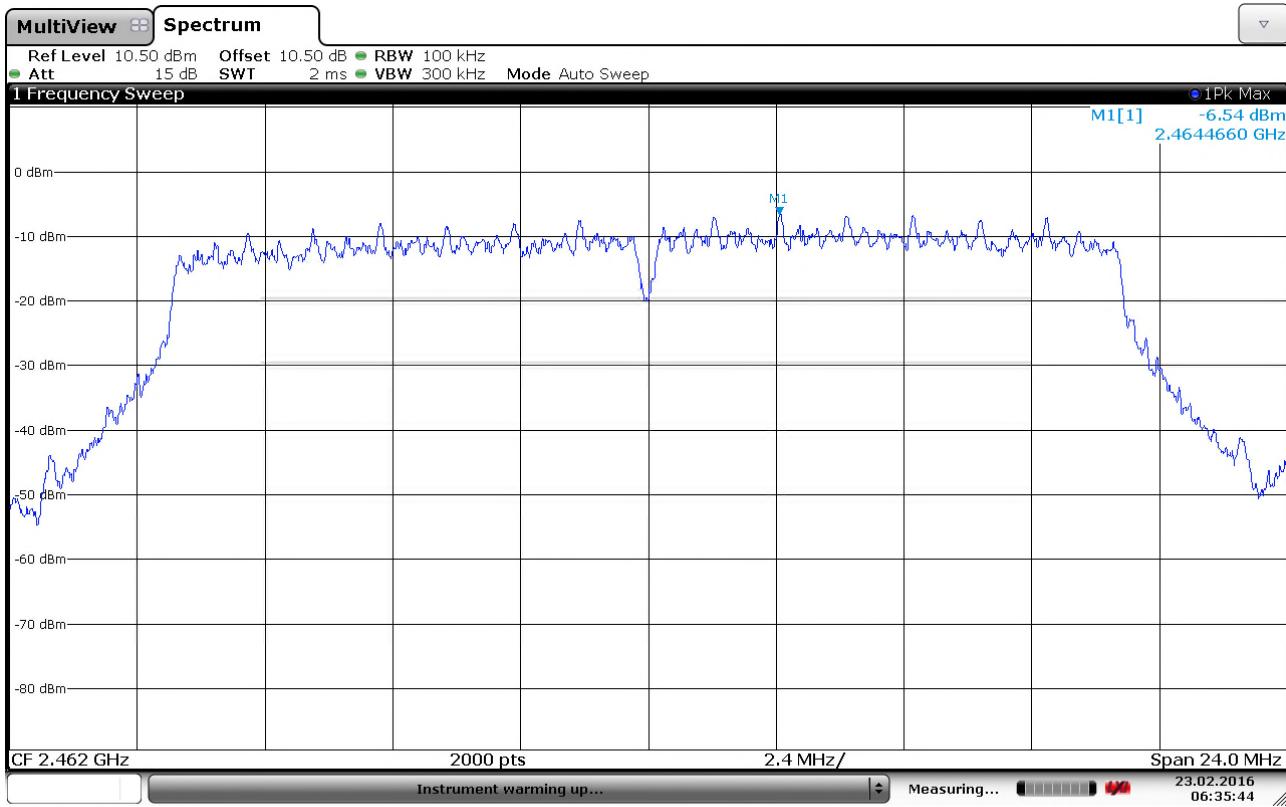
Date: 23.FEB.2016 06:41:26

PSD, 2462 MHz, 802.11b, 5.5 Mbps



Date: 23.FEB.2016 06:42:23

PSD, 2462 MHz, 802.11g, 9 Mbps



PSD, 2462 MHz, 802.11n, 65 Mbps

4 Measurement Uncertainty

Measurement Uncertainty Values		
Test Item		Uncertainty
Output Power		±0.5 dB
Power Spectral Density		±0.5 dB
Out of Band Emissions, Conducted	< 3.6 GHz	±0.6 dB
	> 3.6 GHz	±0.9 dB
Spurious Emissions, Radiated	< 1 GHz	±2.5 dB
	> 1 GHz	±2.2 dB
Emission Bandwidth		±4 %
Power Line Conducted Emissions		+2.9 / -4.1 dB
Spectrum Mask Measurements	Frequency	±5 %
	Amplitude	±1.0 dB
Frequency Error		±0.6 ppm
Temperature Uncertainty		±1 °C

All uncertainty values are expanded standard uncertainty to give a confidence level of 95%, based on coverage factor k=2

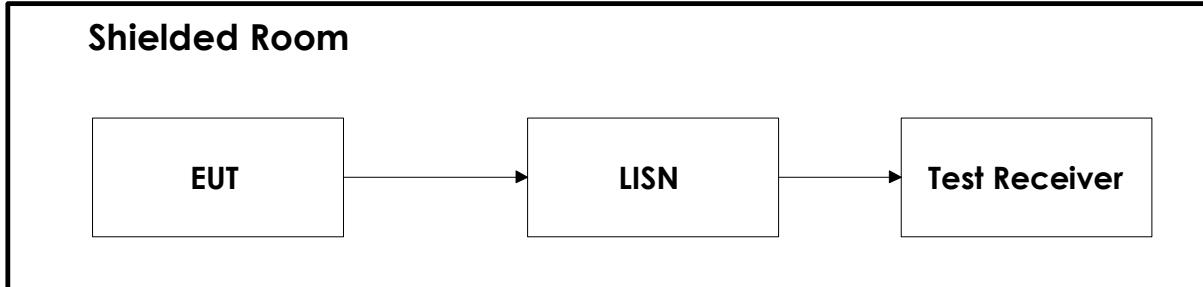
5 LIST OF TEST EQUIPMENT

To facilitate inclusion on each page of the test equipment used for related tests, each item of test equipment and ancillaries are identified (numbered) by the Test Laboratory.

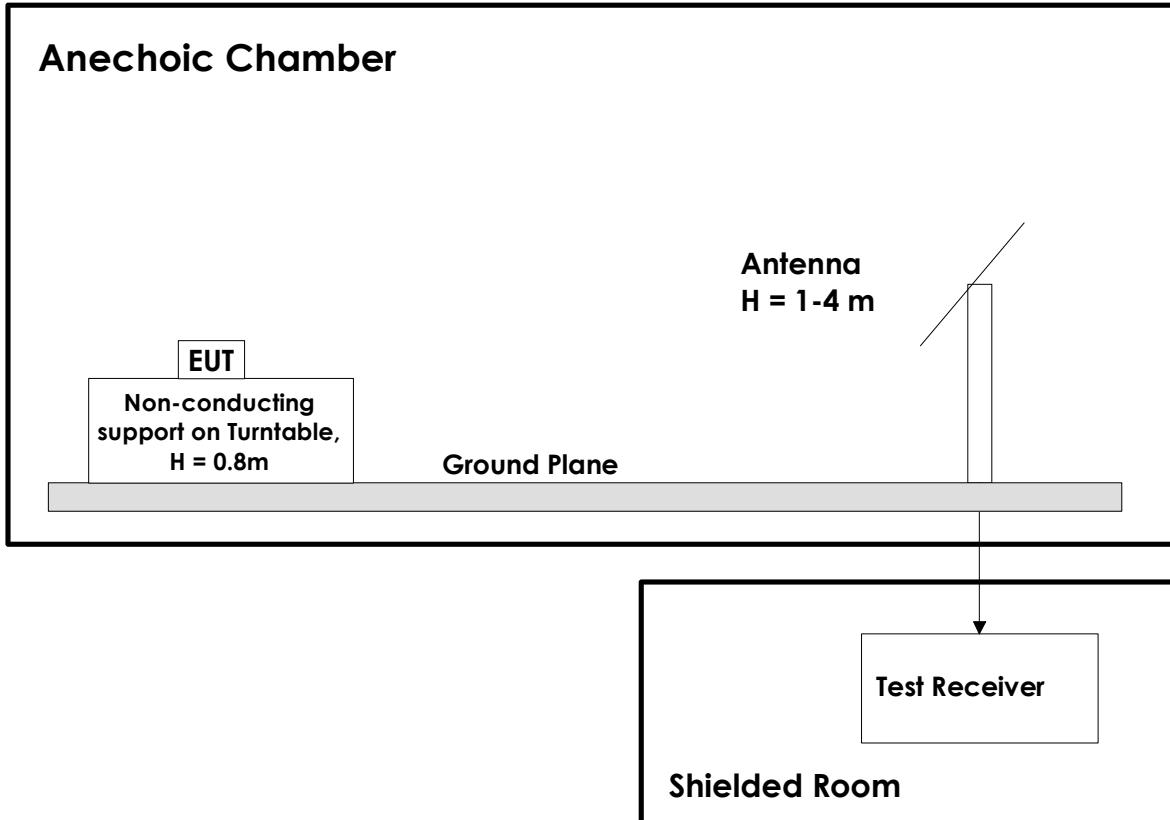
No.	Instrument/ ancillary	Type of instrument/ ancillary	Manufacturer	Ref. no.	Cal. Date	Cal. Due
1.	ESU40	EMI Receiver	Rohde & Schwarz	LR1639	2015.11	2016.11
2.	FSW26	Spectrum Analyzer	Rohde & Schwarz	LR 1640	2015.11	2016.11
3.	HFH2-Z2	Active Loop antenna	Rohde & Schwarz	LR1660	2014.10	2017.10
4.	3115	Antenna horn	EMCO	LR 1330	2010.08	2017.08
5.	HK116	Biconical Antenna	Rohde & Schwarz	LR 1260	2013.12	2016.12
6.	HL223	Log Periodic antenna	Rohde & Schwarz	LR 1261	2013.12	2016.12
7.	643	Antenna Horn	Narda	LR 093	10.2009	10.2019
8.	PM7320X	Antenna Horn	Sivers Lab	LR 102	10.2009	10.2019
9.	DBF-520-20	Antenna Horn	Systron Donner	LR 100	10.2009	10.2019
10.	638	Antenna Horn	Narda	LR 1480	10.2009	10.2019
11.	4768-10	Attenuator	Narda	LR 1356	Cal b4 use	
12.	6HC3000/18000	Highpass Filter	Trilithic	LR 1614	Cal b4 use	
13.	8449B	Pre-amplifier	Hewlett Packard	LR 1322	2015.09	2016.09
14.	HP 10855A	Pre-amplifier	Hewlett Packard	LR 1445	2015.10	2016.10
15.	Model 87 V	Multimeter	Fluke	LR 1597	2015.10	2016.10
16.	6812B	Power source	Agilent	LR 1515	2015.12.02	2017.12.02
17.	D001	DC power supply	Farnell	LT 5150	Cal b4 use	

6 BLOCK DIAGRAM

6.1 Power Line Conducted Emission



6.2 Test Site Radiated Emission





Revision history

Version	Date	Comment	Sign
1.0	2016.06.30	First test report	gns
2.0	2016.08.03	Spurious emissions with all radio active	gns